INDEPENDENT ORBITER ASSESSMENT

**ASSESSMENT
OF THE
ORBITER
EXPERIMENTS
SUBSYSTEM**

05 FEBRUARY 1988

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY
HOUSTON DIVISION

SPACE TRANSPORTATION SYSTEM ENGINEERING AND OPERATIONS SUPPORT

WORKING PAPER NO. 1.0-WP-VA88005-03

INDEPENDENT ORBITER ASSESSMENT
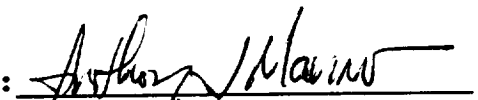ASSESSMENT OF THE ORBITER EXPERIMENT (OEX) SUBSYSTEM

05 FEBRUARY 1988

This Working Paper is Submitted to NASA under
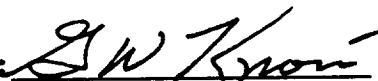Task Order No. VA88005, Contract NAS 9-17650

PREPARED BY: _____
J.M. Compton
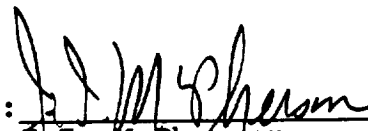OEX Analyst
Independent Orbiter
Assessment

APPROVED BY: _____
A.J. Marino
Section Manager-FMEA/CIL
Independent Orbiter
Assessment

APPROVED BY: _____
G.W. Knori
Technical Manager
Independent Orbiter
Assessment

APPROVED BY: _____
J.I. McPherson
Project Manager
STSEOS

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1.0 EXECUTIVE SUMMARY

The McDonnell Douglas Astronautics Company (MDAC) was selected in
June 1986 to perform an Independent Orbiter Assessment (IOA) of
the Failure Modes and Effects Analysis (FMEA) and Critical Items
List (CIL). Direction was given by the STS Orbiter and GFE
Projects Office to perform the hardware analysis using the
instructions and ground rules defined in NSTS 22206, Instructions
for Preparation of FMEA and CIL, 10 October 1986.

The IOA effort first completed an analysis of the Orbiter
Experiments (OEX) hardware, generating draft failure modes and
potential critical items. To preserve independence, this
analysis was accomplished without reliance upon the results
contained within the NASA FMEA/CIL documentation. The IOA
results were then compared to the NASA FMEA/CIL baseline with
proposed Post 51-L updates included. A resolution of each
discrepancy from the comparison is provided through additional
analysis as required. This report documents the results of that
comparison for the Orbiter OEX hardware.

The IOA product for the OEX analysis consisted of eighty two
failure mode "worksheets" that resulted in two potential critical
items being identified. Comparison was made to the NASA baseline
(as of 1 May 1987) which consisted of one hundred ninety one FMEAs
and one CIL item. The difference in the number of IOA analysis
worksheets and NASA FMEAs can be explained by the different
levels of analysis detail performed to identify failure modes.
The comparison determined if there were any results which had
been found by the IOA but were not in the NASA baseline. This
comparison produced agreement on all but twenty four FMEAs which
caused differences in no CIL items. Figure 1 presents a
comparison of the proposed Post 51-L NASA baseline, with the IOA
recommended baseline, and any issues.

The issues arose due to differences between the NASA and IOA
FMEA/CIL preparation instructions. NASA had used an older ground
rules document which has since been superseded by the NSTS 22206
used by the IOA. After comparison, there were no discrepancies
found that were not already identified by NASA, and the remaining
issues may be attributed to differences in ground rules.

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OEX ASSESSMENT OVERVIEW

OEX ASSESSMENT SUMMARY

	ORIGINAL ASSESSMENT*			FINAL RESOLUTION**		
	IOA	NASA	ISSUES	IOA	NASA	ISSUES
FMEA	82	191	25	81	191	24
CIL	2	1	1	1	1	0

SILTS

	IOA	NASA	ISSUES
FMEA	26	142	2
CIL	0	0	0

ACIP

	IOA	NASA	ISSUES
FMEA	22	14	8
CIL	0	0	0

SSO

	IOA	NASA	ISSUES
FMEA	7	7	20
CIL	0	0	0

SEADS

	IOA	NASA	ISSUES
FMEA	5	1	4
CIL	1	1	0

SUMS

	IOA	NASA	ISSUES
FMEA	16	24	5
CIL	0	0	0

FFSSO

	IOA	NASA	ISSUES
FMEA	5	3	3
CIL	0	0	0

* NASA PROPOSED BASELINE
** FINAL NASA BASELINE AS OF 1 JANUARY 1988
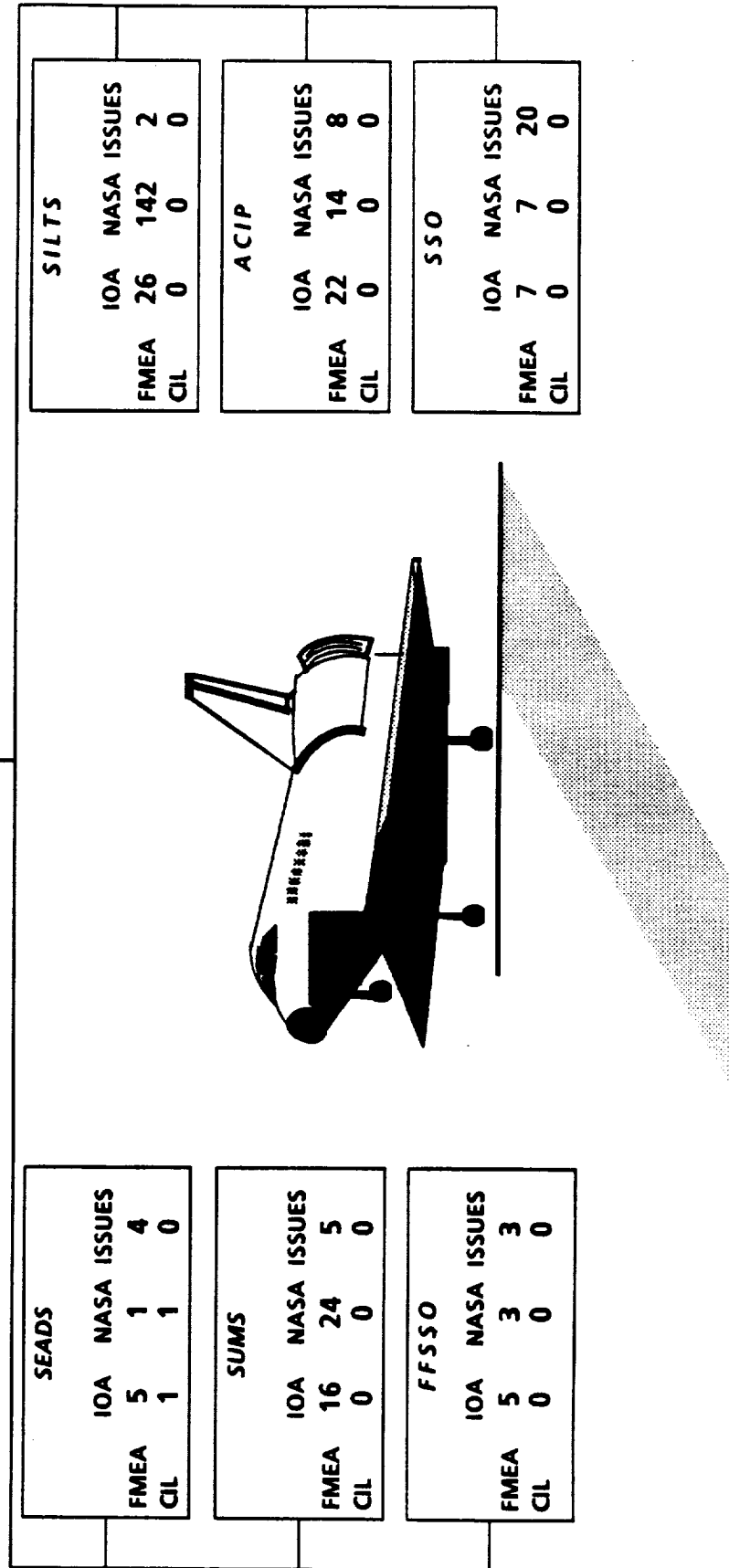
Figure 1 - OEX FMEA/CIL ASSESSMENT

2.0 INTRODUCTION

2.1 Purpose

The 51-L Challenger accident prompted the NASA to readdress safety policies, concepts, and rationale being used in the National Space Transportation System (NSTS). The NSTS Office has undertaken the task of reevaluating the FMEA/CIL for the Space Shuttle design. The MDAC is providing an independent assessment of the proposed Post 51-L Orbiter FMEA/CIL for completeness and technical accuracy.

2.2 Scope

The scope of the independent FMEA/CIL assessment activity encompasses those Shuttle Orbiter subsystems and GFE hardware identified in the Space Shuttle Independent FMEA/CIL Assessment Contractor Statement of Work. Each subsystem analysis addresses hardware, functions, internal and external interfaces, and operational requirements for all mission phases.

2.3 Analysis Approach

The independent analysis approach is a top-down analysis utilizing as-built drawings to breakdown the respective subsystem into components and low-level hardware items. Each hardware item is evaluated for failure mode, effects, and criticality. These data are documented in the respective subsystem analysis report, and are used to assess the proposed Post 51-L NASA and Prime Contractor FMEA/CIL. The IOA analysis approach is summarized in the following Steps 1.0 through 3.0. Step 4.0 summarizes the assessment of the NASA and Prime Contractor FMEA/CIL which is documented in this report.

Step 1.0   Subsystem Familiarization
    1.1   Define subsystem functions
    1.2   Define subsystem components
    1.3   Define subsystem specific ground rules and
         assumptions

Step 2.0   Define subsystem analysis diagram
    2.1   Define subsystem
    2.2   Define major assemblies
    2.3   Develop detailed subsystem representations

Step 3.0   Failure events definition
    3.1   Construct matrix of failure modes
    3.2   Document IOA analysis results

```
Step 4.0  Compare IOA analysis data to NASA FMEA/CIL
          4.1  Resolve differences
          4.2  Review in-house
          4.3  Document assessment issues
          4.4  Forward findings to Project Manager
```

2.4 Ground Rules and Assumptions

The ground rules and assumptions used in the IOA are defined in Appendix B.

3.0 SUBSYSTEM DESCRIPTION

3.1 Design and Function

The Orbiter experiments (OEX) consists of various sets of hardware required to obtain precise data for physics, aerodynamics, thermodynamics, structures, and materials on the orbiter in a flight and orbital environment. Data for the OEX may be from existing sensors in the operational instrumentation (OI), from sensors in the development flight instrumentation (DFI), from new OEX unique sensors, or from combinations of the above. Data recording of the OEX data is provided by the payload recorder, operations recorder, DFI recorder, OEX recorder, the MADS recorder, or combinations thereof. Columbia, OV-102, is the main test-bed for the OEX. Special unique structural interfaces are required for SEADS, SUMS and SILTS, and thus these experiments are only on OV-102. The ACIP experiment can be fitted to any orbiter.

The Orbiter Experiments consists of the following experiments and support systems:

1. Shuttle Entry Air Data System (SEADS) experiment is designed to reference air data (angle of attack, and angle of sideslip) during the entire free-stream, dynamic pressure, atmospheric flight envelope of the orbiter (Entry). Both air pressure and temperature measurements are made to determine temperature compensation of the pressure measurements. The system comprises of 28 pressure transducers (0- to 5- volt outputs), eight temperature sensors (RTD's) which require signal conditioning, and six radiometers which also require signal conditioning; all located on the nose cone of the orbiter (Figure 2). 14 pressure ports, each containing two pressure transducers, are flush-mounted orifices arranged in a cruciform pattern. The pressure distribution obtained from these ports are used to measure dynamic pressure, vehicle attitude, and state.

2. The Shuttle Upper Atmosphere Mass Spectrometer (SUMS) measures the density and composition of the Earth atmosphere beginning approximately 1 hour prior to orbiter re-entry and continues down to an external inlet pressure of 5.18 torr (about 115K Feet). It will provide total atmosphere quantities in regions below that traversed by Earth satellites and above that regularly assessed by ground launched meteorological missions. The SUMS experiment is made up of a gas inlet system and a pressurized enclosure containing a mass spectrometer and electronic control system. Data is fed to a PCM-slave which processes and converts it into a format that can be transmitted to the PCM master then to the recorder. The SUMS and PCM-slave are mounted on the bulkhead at the forward end of the orbiter nose landing gear wheel well with the inlet system fitted to the lower fuselage surface in front of the nose wheel well (Figure 3).

3. Part of the Forward Fuselage Support System for Orbiter Experiments (FFSSO) provides for the collection and handling of experiment data (SEADS and SUMS), while the other part provides sensors for the measurement of static air pressure. Six static pressure ports located on the forward fuselage contain two pressure transducers each used to remove the effects of dynamic pressure (from SEADS) as functions of angle of attack and yaw. In addition, there are six temperature measurements, one for each pair of pressure transducers, for temperature compensation of the measured pressures. There is also one temperature sensor on the PCM slave to verify its health. Data is fed to the PCM slave in the nose wheel well, to the PCM master, and then to the recorder. The FFSSO consists also of all the electrical cabling between transducers, sensors, PCM slave and PCM master (Figure 4).

4. Shuttle Infrared Leeside Temperature Sensor (SILTS) experiment is used to obtain high-resolution temperatures of the orbiter upper (leeside) surfaces during entry aerodynamic flight. An infrared (IR) camera, mounted in a pod on top of the vertical fin, is used to produce thermal maps on the orbiter upper surface. These data will improve orbiter operational capability through reduction of the upper thermal protection system (TPS) which will reduce weight and refurbishment costs. Experiment equipment mounted within the pod includes pressure system module, data and control (D&C) module, dome assembly/IR camera, and window protection plugs (Figure 5). The pressure system (GN2) provides coolant for the windows and IR camera and also provides pressure for window plug release. The IR camera alternately views the forward fuselage, black body, and port wing during a 7-second cycle, controlled by camera pointing circuitry in the D&C module. The D&C module also provides an output data interface between the IR camera and the OEX recorder via the ICM/SCM. Heaters in the pod are activated by the crew after launch to regulate the pod temperature between 60 and 80 degrees F throughout the mission. During the entry switch configuration, the crew will enable the experiment switches so that it will receive a start command at entry interface (EI).

5. The Aerodynamic Coefficient Identification Package (ACIP) is to collect and measure the accelerations (linear in X, Y, and Z and angular in roll, pitch and yaw) and rates (roll, pitch, and yaw) of the orbiter. The aerodynamic forces cause the vehicle to slow down from orbital velocity to landing speed during re-entry. The data collected by ACIP is of greater resolution than the standard orbiter onboard instrumentation. The ACIP hardware, mounted in a self-contained package, consists of a Triaxial Accelerometer/Gyro Instrument Package (TAGIP), Triaxial Angular Accelerometer (TAA), Triaxial Vibration Sensor (TVS), Data-Handling Electronics (DHE), and Mini Data-Handling Electronics (MDHE). The package is located beneath the payload bay

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insulation liner near the longitudinal center of gravity
(Figure 6). The High-Resolution Accelerometer Package
(HIRAP) was added as a separate major subassembly. It
provides a third set of triaxial accelerometer sensors to
complement the TAGIP and TAA. Other ACIP associated
equipment are the Pulse Code Modulation (PCM) Master and a
PCM slave. The PCM master handles data from SEADS, SUMS and
FFSSO as well as ACIP. The PCM slave handles the analog
data from ACIP to the PCM master (Figure 7). Data from
these experiments is then routed to the ICM/SCM then to the
OEX recorder. Heaters are installed on the package to
maintain temperature greater than 45±5 degrees F during
orbital flight. Minimal crew participation is required,
since the experiment operations is performed by commands
from the ground. Operation is required during ascent, entry
and specific orbital tests.

6.   The objective of the Support System for Orbiter Experiments
(SSO) is to provide control, conditioning, handling and
recording of the experiments data. The SSO consists of the
OEX Recorder, a control module [either the interface control
module (ICM) or the system control module (SCM)], and the
wiring and cabling. The equipment is located in the crew
compartment Volume D. As a result, the SSO is
removed on a Spacelab mission, since it requires this
space. The control module is the primary interface
between the OEX recorder and experiment instruments, and
the orbiter (Figure 8). It controls the OEX recorder
speed, record mode, and track selection along with
experiment power and mode. It is controlled via uplink
commands except for power and it has no telemetry. The
OEX recorder records all the OEX experiments data and
can only be accessed post-mission through ground support
equipment.

3.2   Interfaces and Location

The Orbiter Experiments hardware, for this analysis,
consists of four experiments and two support systems. The
interfaces for the OEX are relatively simple in that there
is a limited number of interfaces with subsystems on the
orbiter. Most experiments are controlled via uplink command
through the Communications System then through the Data
Processing System (DPS) to the experiment. Timing functions
are fed into PCMs for comparison and update to internal
time. Control surface measurements are input into the ACIP
experiment for comparison of their movement to the sensed
aerodynamics of the orbiter. Lastly, a few switches are
available on panel A7 for manual control of some of the
experiments. The location of each of the experiments,
support systems, and controls is shown in Figure 9.

3.3 Hierarchy

Figure 10 illustrates the hierarchy of the OEX experiments and the corresponding subcomponents. Figures 2 through 8 comprise the detailed system representation.

NOSE CAP

28 PRESSURE TRANSDUCERS (14 PRESSURE PORTS)
 6 RADIOMETERS
 8 TEMPERATURE SENSORS
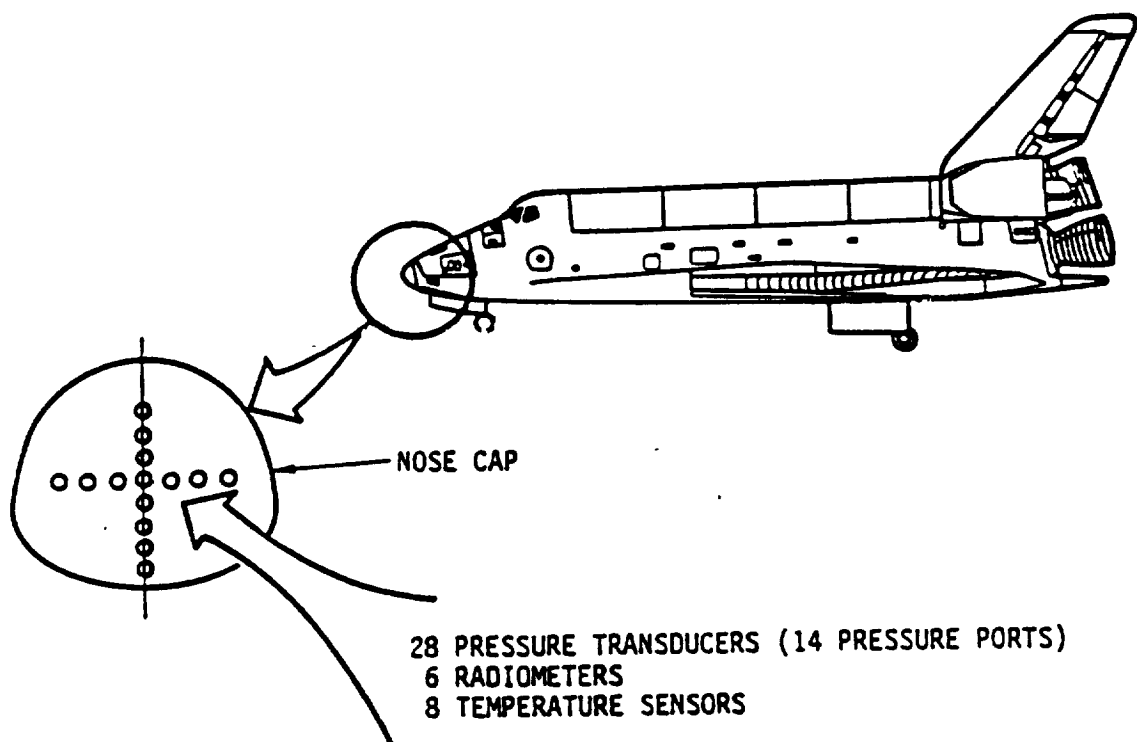
Figure 2 - SEADS HARDWARE
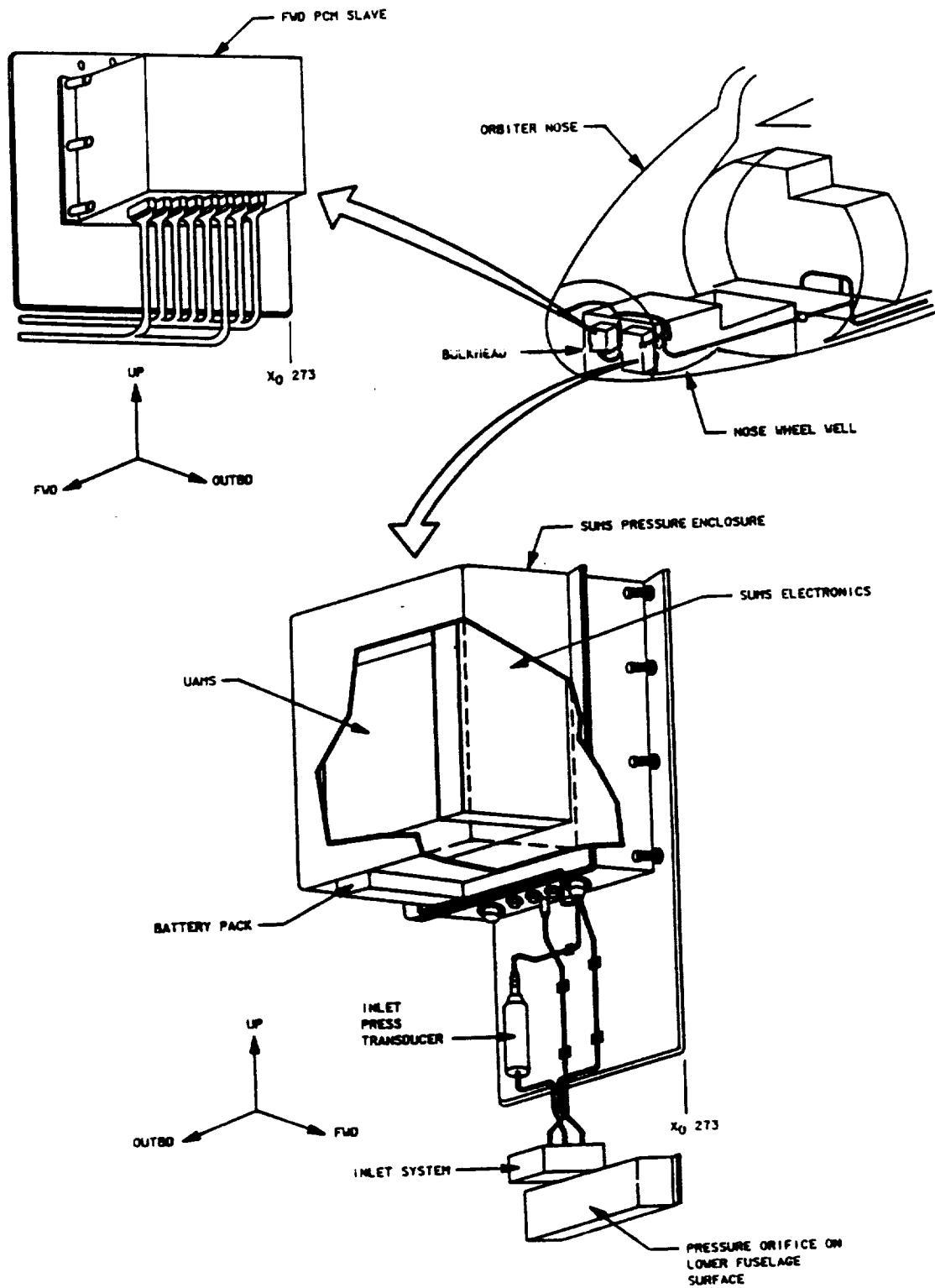
Figure 3 - SUMS HARDWARE LOCATION

PRESSURE
TRANSDUCERS

TEMP

PRESS

PCM
SLAVE
NO. 2

TEMP

TEMPS

TO ACIP
PCM-MU

SEADS

PRESS

TEMP

SIG
COND

SUMS
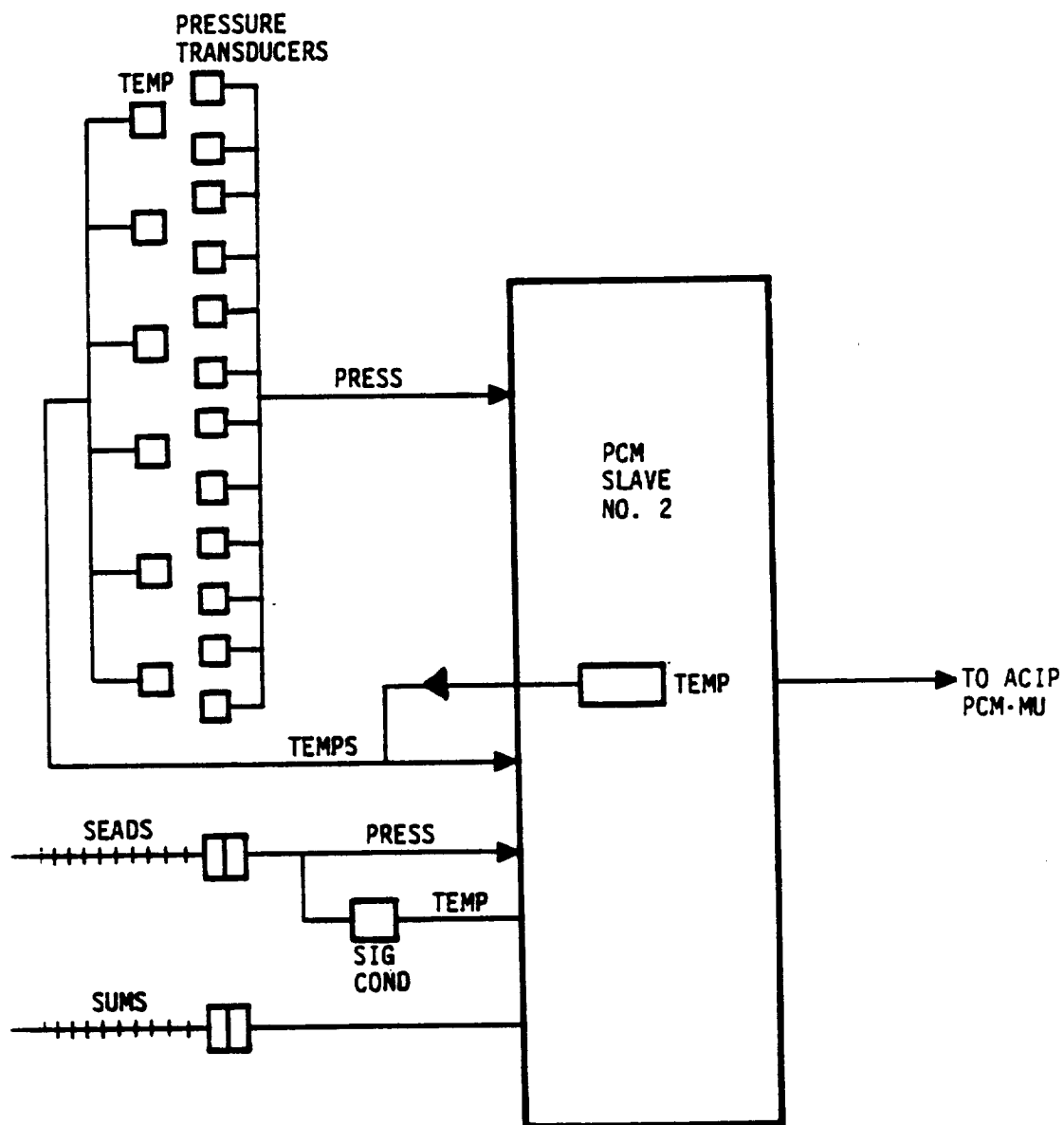
Figure 4 - FFSSO BLOCK DIAGRAM
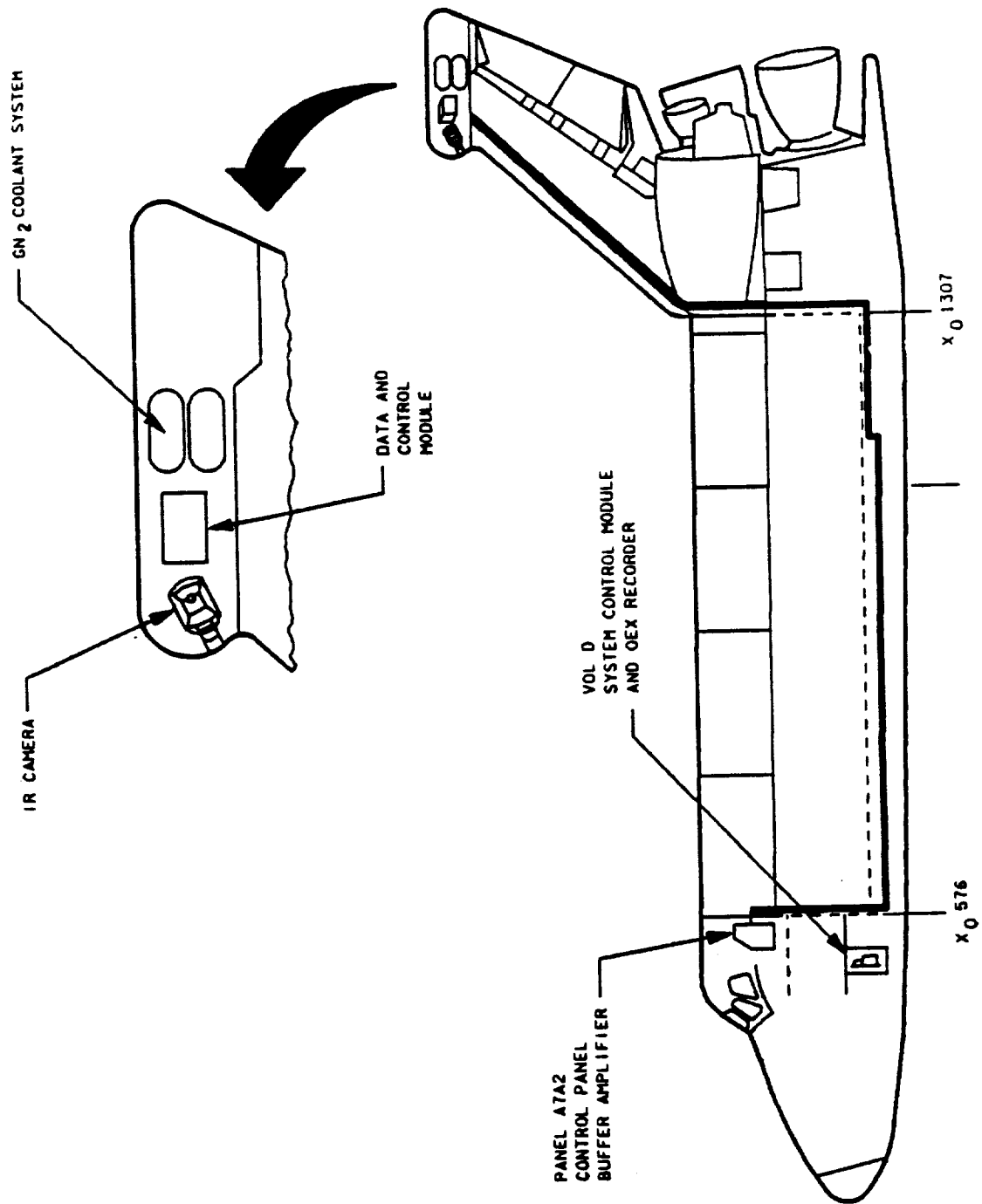
Figure 5 - SILTS EXPERIMENT AND SUPPORT HARDWARE

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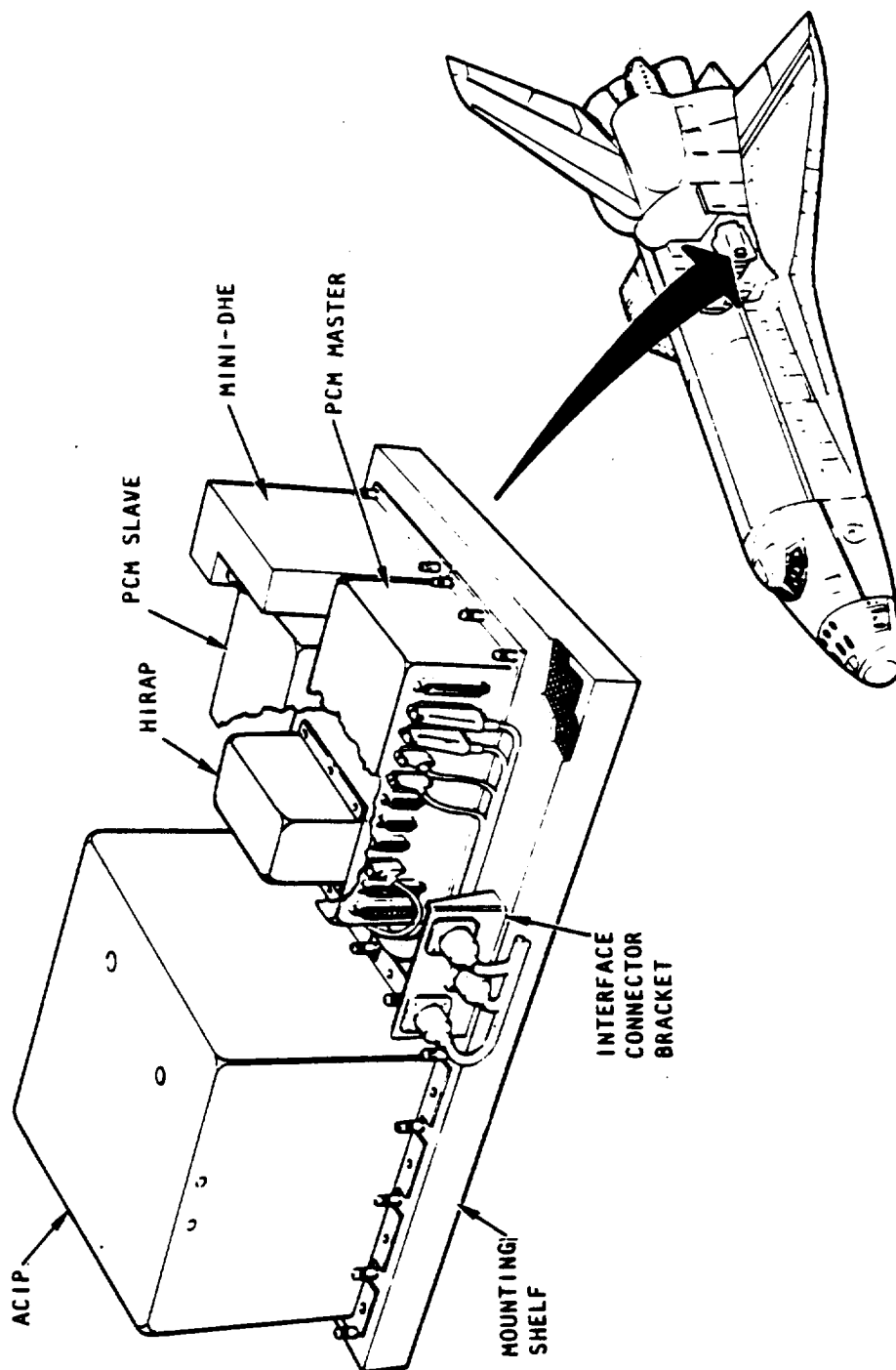
Figure 6 - ACIP EXPERIMENT
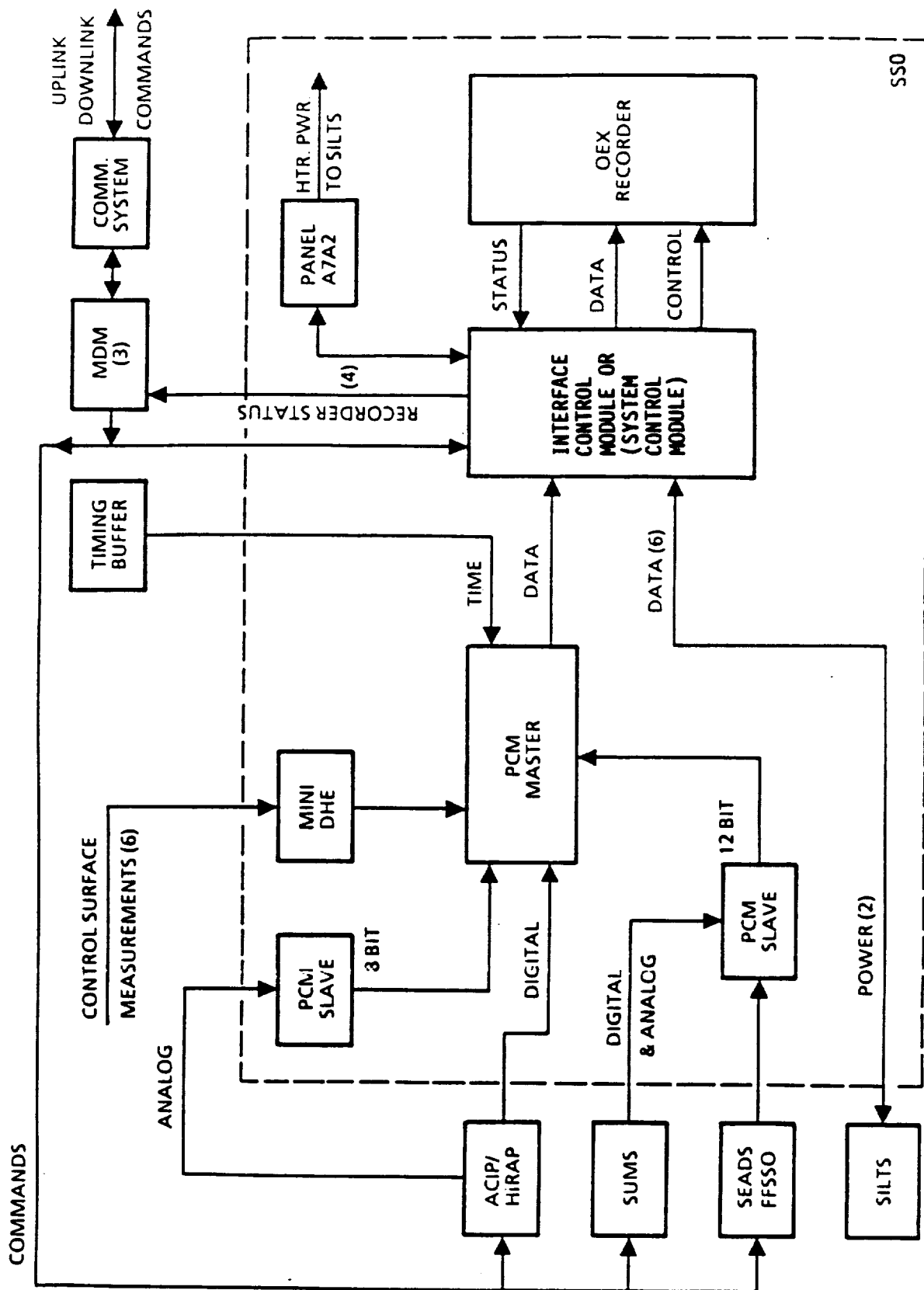
Figure 7 - OEX DATA FLOW SUMMARY
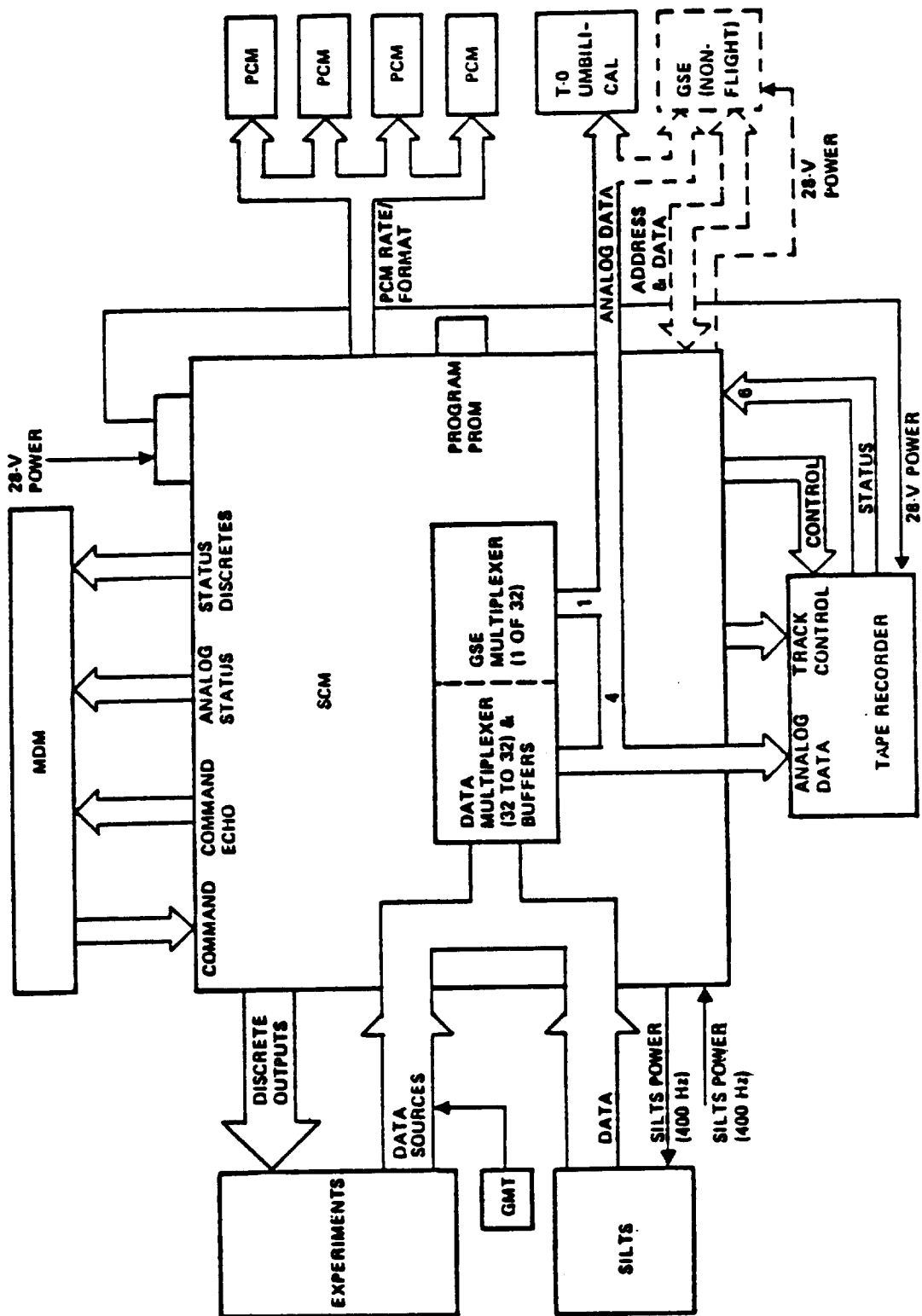
Figure 8 — OEX SCM SYSTEM CONFIGURATION

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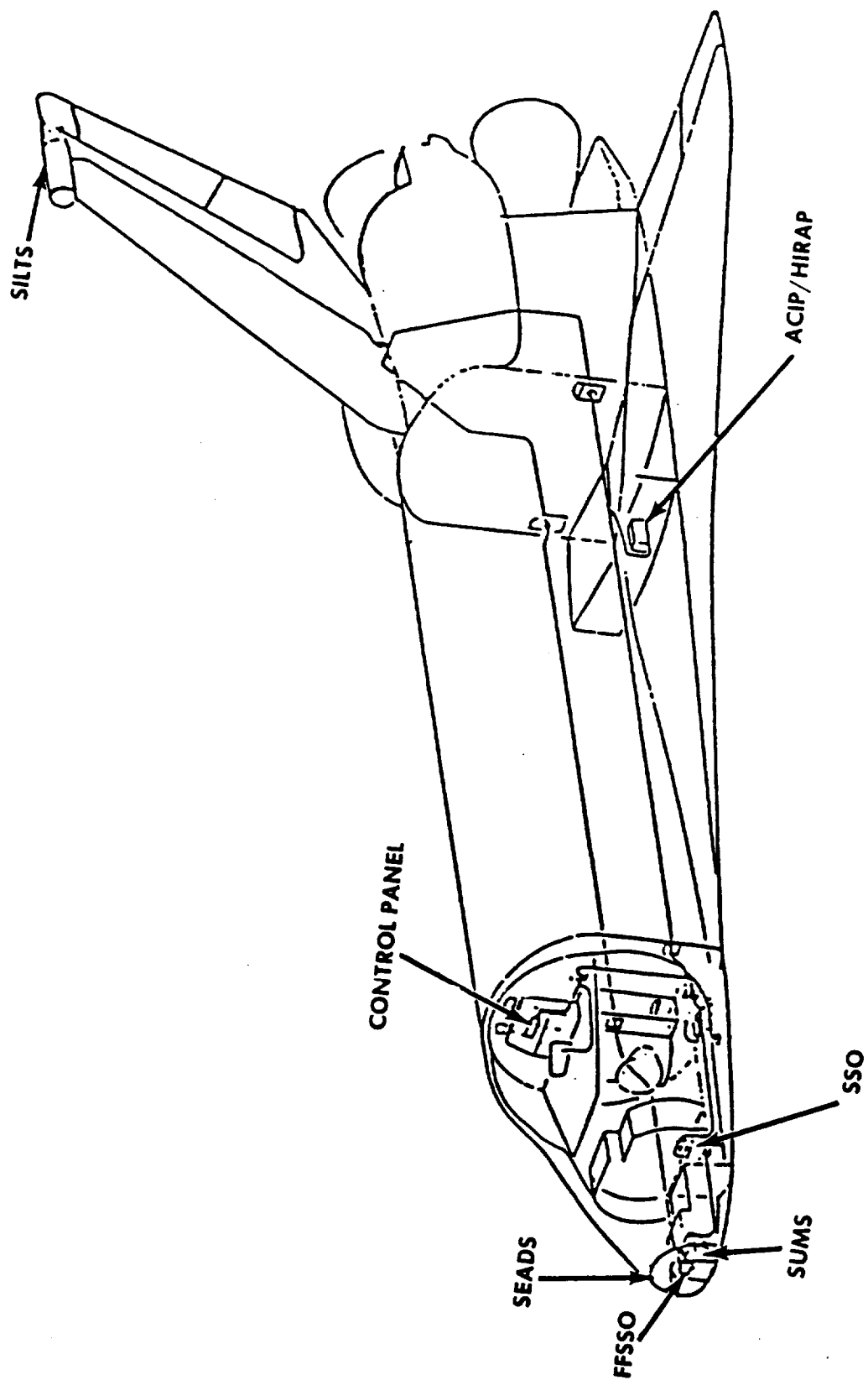
Figure 9 - OEX COMPLEMENT AS OF APRIL 1987

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ORBITER EXPERIMENTS (OEX) OVERVIEW

ORBITER EXPERIMENTS

SEADS
●PRESSURE TRANSDUCERS
●RADIOMETERS
●TEMPERATURE SENSORS

SUMS
●GAS INLET SYSTEM
●MASS SPECTROMETER
●ELECTRONIC CONTROL SYSTEM

SILTS
●DOME ASSEMBLY /
 IR CAMERA
●PRESSURE SYSTEM
 MODULE
●DATA & CONTROL
 MODULE

ACIP
●TAGIP ●PCM
●TAA   MASTER
●TVS   ●PCM
●DHE   SLAVE # 1
●MDHE
●HIRAP

FFSSO
●PRESSURE TRANSDUCERS
●TEMPERATURE SENSORS
●PCM SLAVE # 2

SSO
●ICM / SCM
●OEX RECORDER

Figure 10 - ORBITER EXPERIMENTS OVERVIEW

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4.0   ASSESSMENT RESULTS

The IOA analysis of the OEX hardware initially generated eighty-two (82) failure mode worksheets and identified two (2) Potential Critical Items (PCIs) before starting the assessment process. These analysis results were compared to the proposed NASA Post 51-L baseline of 191 FMEAs and one (1) CIL item, which was generated using the older FMEA/CIL instructions. Upon completion of the assessment, one-hundred sixty-seven (167) of the one-hundred ninety-one (191) FMEAs were in agreement. Of the twenty-four (24) that remained, twenty-one (21) were IOA 3/3 FMEAs on component not addressed by NASA. Of the remaining three (3), two (2) issues were with FMEAs criticality level. The remaining issue concerns a FMEA on a component which no longer exist, thus no FMEA needed.

In the following, the unmapped IOA column is the raw number of IOA failure modes. The mapped IOA column is the number of IOA failure modes after they have been mapped into the NASA FMEAs. The issues column is the IOA failure modes that were unable to be mapped onto FMEAs.

OEX Sections	IOA Unmapped	IOA Mapped	NASA	ISSUES
SEADS	5	1	1	4
SUMS	16	12	24*	4
FFSSO	5	3	3	2
SILTS	26	24	142*	2
ACIP	22	14	14	8
SSO	7	6	7	1

* Level of detail greater than other experiments and that required in 22206.

A summary of the quantity of NASA FMEAs assessed, versus the recommended IOA baseline, and any issues identified is presented in Table I.

Table I Summary of IOA FMEA Assessment			
Component	NASA	IOA	Issues
SEADS	1	5	4
SUMS	24	16	5
FFSSO	3	5	3
SILTS	142	26	2
ACIP	14	22	8
SSO	7	7	2
TOTAL	191	81	24

A summary of the quantity of NASA CIL items assessed, versus the recommended IOA baseline, and any issues identified is presented in Table II.

```
+----------------------------------------------------------------+
|           Table II  Summary of IOA CIL Assessment              |
+------------------+-----------+----------+----------------------+
|    Component     |   NASA    |   IOA    |       Issues         |
+------------------+-----------+----------+----------------------+
|       SEADS      |     1     |    1     |          -           |
|       SUMS       |     -     |    -     |          -           |
|       FFSSO      |     -     |    -     |          -           |
|       SILTS      |     -     |    -     |          -           |
|       ACIP       |     -     |    -     |          -           |
|       SSO        |     -     |    -     |          -           |
|                  |           |          |                      |
+------------------+-----------+----------+----------------------+
|       TOTAL      |     1     |    1     |          0           |
+------------------+-----------+----------+----------------------+
```

Appendix C presents the detailed assessment worksheets for each failure mode identified and assessed. Appendix D highlights the NASA Critical Items and corresponding IOA worksheet ID. Appendix E contains IOA analysis worksheets supplementing previous analysis results reported in Space Transportation System Engineering and Operations Support (STSEOS) Working Paper No. 1.0-WP-VA87005-01, Analysis of the OEX, 21 August 1987. Appendix F provides a cross reference between the NASA FMEA and corresponding IOA worksheet(s). IOA recommendations are also summarized.

Table III presents a summary of the IOA recommended failure criticalities for the Post 51-L FMEA baseline. Further discussion of each of these subdivisions and the applicable failure modes is provided in subsequent paragraphs.

```
+--------------------------------------------------------------------------+
| TABLE III   Summary of IOA Recommended Failure Criticalities             |
+---------------+-----+------+-----+------+------+-----+-------+
| Criticality:  | 1/1 | 2/1R | 2/2 | 3/1R | 3/2R | 3/3 | TOTAL |
|               |     |      |     |      |      |     |       |
|      SEADS    |  1  |  -   |  -  |  -   |  -   |  4  |   5   |
|      SUMS     |  -  |  -   |  -  |  -   |  -   | 16  |  16   |
|      FFSSO    |  -  |  -   |  -  |  -   |  -   |  5  |   5   |
|      SILTS    |  -  |  -   |  -  |  -   |  -   | 26  |  26   |
|      ACIP     |  -  |  -   |  -  |  -   |  -   | 22  |  22   |
|      SSO      |  -  |  -   |  -  |  -   |  -   |  7  |   7   |
+---------------+-----+------+-----+------+------+-----+-------+
|     TOTAL     |  1  |  -   |  -  |  -   |  -   | 80  |  81   |
+---------------+-----+------+-----+------+------+-----+-------+
```

Of the failure modes analyzed, one was determined to be a critical item. A summary of the IOA recommended critical items is presented in Table IV.

TABLE IV Summary of IOA Recommended Critical Items							
Criticality:	1/1	2/1R	2/2	3/1R	3/2R	3/3	TOTAL
SEADS	1	-	-	-	-	-	1
SUMS	-	-	-	-	-	-	-
FFSSO	-	-	-	-	-	-	-
SILTS	-	-	-	-	-	-	-
ACIP	-	-	-	-	-	-	-
SSO	-	-	-	-	-	-	-
TOTAL	1	-	-	-	-	-	1

The scheme for assigning IOA assessment (Appendix C) and analysis (Appendix E) worksheet numbers is shown in Table V.

Table V IOA Worksheet Numbers	
Component	IOA ID Number
SEADS	OEX-100 TO OEX-105
SUMS	OEX-200 TO OEX-215
FFSSO	OEX-300 TO OEX-304
SILTS	OEX-400 TO OEX-426
ACIP	OEX-500 TO OEX-521
SSO	OEX-600 TO OEX-606

4.1 SEADS Assessment Results

The assessment between the IOA failure modes and the Post 51-L NASA FMEA baseline produced five issues. One issue involved the SEADS Nose Cap Assembly (MDAC ID 100) that had no corresponding NASA FMEA. It was decided to drop this FMEA/CIL since the item is really part of the Orbiter structure, plus it is protected by the tile. THe other four issues involve components that had no corresponding NASA FMEAs which should be addressed. However, their criticality level is only 3/3.

4.2 SUMS Assessment Results

The IOA analysis generated sixteen failure modes from the SUMS experiment. The assessment between the SUMS failure modes and the Post 51-L NASA FMEA/CIL baseline produced five issues. One issue involved the SUMS Instrument Assembly (MDAC ID 200) (NASA FMEA FWFS 02-1) difference in criticality level. The other four issues involved components that had no corresponding NASA FMEAS which should be addressed. However, their criticality level is only 3/3.

4.3 FFSSO Assessment Results

During the assessment, five FFSSO failure modes were compared to the Post 51-L NASA FMEA/CIL baseline which produced three issues. One issue involved the PCM Slave #2 (MDAC ID 300) (NASA FMEA FWFS01-1) criticality level. The other two issues involved components that had no corresponding NASA FMEAs which should be addressed. However, their criticality level is only 3/3.

4.4 SILTS Assessment Results

The IOA analysis produced twenty six failure modes from the SILTS experiment. The assessment between the SILTS failure modes and the Post 51-L NASA FMEA/CIL baseline produced two issues. Both these issues involved components that had no corresponding NASA FMEAs which should be addressed. However, their criticality level is only 3/3.

4.5 ACIP Assessment Results

In assessing the twenty two ACIP IOA failure modes and the Post 51-L NASA FMEA/CIL baseline, eight issues were identified. All these issues involved components that had no corresponding NASA FMEAs which should be addressed. However, their criticality level is only 3/3.

4.6 SSO Assessment Results

Seven IOA failure modes were generated for the SSO. The assessment between these and the Post 51-L NASA FMEA/CIL baseline produced two issues. One issue involved FDM-FMR1, FMF3 (NASA FMEA ACIP08-1) which was only on the OV099 vehicle, thus FMEA no longer required. The other issue involved transducers, sensors (MDAC ID 606). These were not addressed in the NASA FMEAS. However, their criticality level is only 3/3.

5.0 REFERENCES

Reference documentation available from NASA and Rockwell was used in the analysis. The documentation used included the following:

1. STS 83-0546A, Space Shuttle Orbiter Experiments Integrated Systems Document, December 1985

2. JSC-19345, Cargo Systems Manual: OEX, STS-ALL, Basic, Rev A, October 25, 1985

3. ICD-3-0049-04, Orbiter Experiment (OEX) System Control Module Interfaces, June 8, 1982

4. V565-763200, OEX Interface Control Module-Assembly, Rev C, December 10, 1981

5. ICD-3-0048-02, Shuttle Infrared Leeside Temperature Sensing (SILTS)/Experiment Interface, January 29, 1979

6. V570-760472, Schematic Diagram ACIP Experiment System, Rev. B, January 22, 1987

7. V570-760462, Schematic Diagram ACIP Experiment System, Rev. C, December 16, 1986

8. ICD-3-0048-09, Aerodynamic Coefficient Identification Package, OV-102 Interface, Physical-Electrical, November 30, 1978

9. V581-000002, OEX Recorder - General Assembly, Basic, April 20, 1979

10. V565-707001, Equipment Installation - Fin Tip Pod (SILTS), Basic, January 24, 1980

11. V570-760422, ACIP Experiment System, Basic, December 1985.

APPENDIX A
ACRONYMS

ACIP	– Aerodynamic Coefficient Instrumentation Package
CIL	– Critical Items List
CMD	– Command, Commander
COMM	– Communication
CRIT	– Criticality
D&C	– Displays and Controls
DCM	– Display and Control Module
DFI	– Development Flight Instrumentation
DHE	– Data-Handling Electronics
DPS	– Data Processing System (Subsystem)
EI	– Entry Interface
F	– Fahrenheit
F	– Functional
FFSSO	– Forward Fuselage Support System for OEX
FLCA	– Forward Load Control Assembly
FMEA	– Failure Modes and Effects Analysis
ft	– Feet
FWD	– Forward
GFE	– Government Furnished Equipment
GMT	– Greenwich Mean Time
GN2	– Gaseous Nitrogen
GSE	– Ground Support Equipment
HIRAP	– High-Resolution Accelerometer Package
HTR	– Heater
HW	– Hardware
ICM	– Interface Control Module
IOA	– Independent Orbiter Assessment
IR	– Infrared
JSC	– Johnson Space Center
MADS	– Modular Auxiliary Data System
MDAC	– McDonnell Douglas Astronautics Company
MDHE	– Mini Data-Handling Electronics
MDM	– Multiplexer/Demultiplexer
N2	– Nitrogen
NASA	– National Aeronautics and Space Administration
NSTS	– National Space Transportation System
OEX	– Orbiter Experiments
OI	– Operational Instrumentation
OPS	– Operations Sequence
PCI	– Potential Critical Item
PCM	– Pulse Code Modulation
PCMMU	– Pulse Code Modulation Master Unit
PWR	– Power
RCDR	– Recorder
RTD	– Resistance Temperature Device
SCM	– System Control Module
SEADS	– Shuttle Entry Air Data System

ACRONYMS

SILTS	- Shuttle Infrared Leeside Temperature Sensor
SSO	- Space Shuttle Orbiter
STS	- Space Transportation System
SUMS	- Shuttle Upper Atmosphere Mass Spectrometer
TAA	- Triaxial Angular Accelerometer
TAGIP	- Triaxial Angular Accelerometer
TPS	- Thermal Protection System
TVS	- Triaxial Vibration Sensor

APPENDIX B

DEFINITIONS, GROUND RULES, AND ASSUMPTIONS

APPENDIX B
DEFINITIONS, GROUND RULES, AND ASSUMPTIONS

B.1 Definitions

Definitions contained in <u>NSTS 22206, Instructions For Preparation of FMEA/CIL, 10 October 1986</u>, were used with the following amplifications and additions.

<u>INTACT ABORT DEFINITIONS:</u>

> <u>RTLS</u> - begins at transition to OPS 6 and ends at transition to OPS 9, post-flight

> <u>TAL</u> - begins at declaration of the abort and ends at transition to OPS 9, post-flight

> <u>AOA</u> - begins at declaration of the abort and ends at transition to OPS 9, post-flight

> <u>ATO</u> - begins at declaration of the abort and ends at transition to OPS 9, post-flight

<u>CREDIBLE (CAUSE)</u> - an event that can be predicted or expected in anticipated operational environmental conditions. Excludes an event where multiple failures must first occur to result in environmental extremes

<u>CONTINGENCY CREW PROCEDURES</u> - procedures that are utilized beyond the standard malfunction procedures, pocket checklists, and cue cards

<u>EARLY MISSION TERMINATION</u> - termination of onorbit phase prior to planned end of mission

<u>EFFECTS/RATIONALE</u> - description of the case which generated the highest criticality

<u>HIGHEST CRITICALITY</u> - the highest functional criticality determined in the phase-by-phase analysis

<u>MAJOR MODE (MM)</u> - major sub-mode of software operational sequence (OPS)

<u>MC</u> - Memory Configuration of Primary Avionics Software System (PASS)

<u>MISSION</u> - assigned performance of a specific Orbiter flight with payload/objective accomplishments including orbit phasing and altitude (excludes secondary payloads such as GAS cans, middeck P/L, etc.)

MULTIPLE ORDER FAILURE - describes the failure due to a single cause or event of all units which perform a necessary (critical) function

OFF-NOMINAL CREW PROCEDURES - procedures that are utilized beyond the standard malfunction procedures, pocket checklists, and cue cards

OPS - software operational sequence

PRIMARY MISSION OBJECTIVES - worst case primary mission objectives are equal to mission objectives

PHASE DEFINITIONS:

       PRELAUNCH PHASE - begins at launch count-down Orbiter power-up and ends at moding to OPS Major Mode 102 (liftoff)

       LIFTOFF MISSION PHASE - begins at SRB ignition (MM 102) and ends at transition out of OPS 1 (Synonymous with ASCENT)

       ONORBIT PHASE - begins at transition to OPS 2 or OPS 8 and ends at transition out of OPS 2 or OPS 8

       DEORBIT PHASE - begins at transition to OPS Major Mode 301 and ends at first main landing gear touchdown

       LANDING/SAFING PHASE - begins at first main gear touchdown and ends with the completion of post-landing safing operations

APPENDIX B
DEFINITIONS, GROUND RULES, AND ASSUMPTIONS

B.2   IOA Project Level Ground Rules and Assumptions

The philosophy embodied in <u>NSTS 22206, Instructions for Preparation of FMEA/CIL, 10 October 1986</u>, was employed with the following amplifications and additions.

1.   The operational flight software is an accurate implementation of the Flight System Software Requirements (FSSRs).

>   RATIONALE: Software verification is out-of-scope of this task.

2.   After liftoff, any parameter which is monitored by system management (SM) or which drives any part of the Caution and Warning System (C&W) will support passage of Redundancy Screen B for its corresponding hardware item.

>   RATIONALE: Analysis of on-board parameter availability and/or the actual monitoring by the crew is beyond the scope of this task.

3.   Any data employed with flight software is assumed to be functional for the specific vehicle and specific mission being flown.

>   RATIONALE: Mission data verification is out-of-scope of this task.

4.   All hardware (including firmware) is manufactured and assembled to the design specifications/drawings.

>   RATIONALE: Acceptance and verification testing is designed to detect and identify problems before the item is approved for use.

5.   All Flight Data File crew procedures will be assumed performed as written, and will not include human error in their performance.

>   RATIONALE: Failures caused by human operational error are out-of-scope of this task.

6. All hardware analyses will, as a minimum, be performed at the level of analysis existent within NASA/Prime Contractor Orbiter FMEA/CILs, and will be permitted to go to greater hardware detail levels but not lesser.

  RATIONALE: Comparison of IOA analysis results with other analyses requires that both analyses be performed to a comparable level of detail.

7. Verification that a telemetry parameter is actually monitored during AOS by ground-based personnel is not required.

  RATIONALE: Analysis of mission-dependent telemetry availability and/or the actual monitoring of applicable data by ground-based personnel is beyond the scope of this task.

8. The determination of criticalities per phase is based on the worst case effect of a failure for the phase being analyzed. The failure can occur in the phase being analyzed or in any previous phase, whichever produces the worst case effects for the phase of interest.

  RATIONALE: Assigning phase criticalities ensures a thorough and complete analysis.

9. Analysis of wire harnesses, cables, and electrical connectors to determine if FMEAs are warranted will not be performed nor FMEAs assessed.

  RATIONALE: Analysis was substantially complete prior to NSTS 22206 ground rule redirection.

10. Analysis of welds or brazed joints that cannot be inspected will not be performed nor FMEAs assessed.

  RATIONALE: Analysis was substantially complete prior to NSTS 22206 ground rule redirection.

11. Emergency system or hardware will include burst discs and will exclude the EMU Secondary Oxygen Pack (SOP), pressure relief valves and the landing gear pyrotechnics.

  RATIONALE: Clarify definition of emergency systems to ensure consistency throughout IOA project.

APPENDIX B
DEFINITIONS, GROUND RULES, AND ASSUMPTIONS

B.3   OEX-Specific Ground Rules and Assumptions

The IOA analysis was performed to the component or assembly level of the OEX subsystem. The analysis considered the worst case effects of the hardware or functional failure on the subsystem, mission, and crew and vehicle safety.

1.   Experiments which develop problems which do not impact the operation and safety of the orbiter will be classifed Criticality 3.

   Rationale: Loss of mission will refer to the overall orbiter mission not individual elements.

2.   Analysis was only conducted on present experiments and support systems planned for future missions.

   Rationale: Experiments and support systems flown in the part which are not manifested on future mission are excluded from FMEA/CIL analysis.

3.   OASIS Experiment excluded from this analysis.

   Rationale: OASIS is considered a payload by the Orbiter Project Office and is thus excluded from this analysis.

APPENDIX C
DETAILED ASSESSMENT

This section contains the IOA assessment worksheets generated during the assessment of this subsystem. The information on these worksheets facilitates the comparison of the NASA FMEA/CIL (Pre and Post 51-L) to the IOA detailed analysis worksheets included in Appendix E. Each of these worksheets identifies the NASA FMEA being assessed, corresponding MDAC Analysis Worksheet ID (Appendix E), hardware item, criticality, redundancy screens, and recommendations. For each failure mode, the highest assessed hardware and functional criticality is compared and discrepancies noted as "N" in the compare row under the column where the discrepancy occurred.

LEGEND FOR IOA ASSESSMENT WORKSHEETS

Hardware Criticalities:
  1   = Loss of life or vehicle
  2   = Loss of mission or next failure of any redundant item
        (like or unlike) could cause loss of life/vehicle
  3   = All others

Functional Criticalities:
  1R = Redundant hardware items (like or unlike) all of which,
        if failed, could cause loss of life or vehicle
  2R = Redundant hardware items (like or unlike) all of which,
        if failed, could cause loss of mission

Redundancy Screens A, B and C:
  P   = Passed Screen
  F   = Failed Screen
  NA = Not Applicable

NASA Data :
  Baseline = NASA FMEA/CIL
  New   = Baseline with Proposed Post 51-L Changes

CIL Item :
  X   = Included in CIL

Compare Row :
  N   = Non compare for that column (deviation)

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-100   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 100
ITEM: SEADS NOSE CAP ASSEMBLY

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[/]	[ ]	[ ]	[ ]	[ ] *
IOA	[1 /1]	[ ]	[ ]	[ ]	[X]
COMPARE	[N /N]	[ ]	[ ]	[ ]	[N]

RECOMMENDATIONS: (If different from NASA)

        [/]   [ ]   [ ]   [ ]   [D]
                                            (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                    ADEQUATE   [   ]
                                    INADEQUATE [   ]
REMARKS:
NO NASA FMEA EXIST ON THIS. HOWEVER, SINCE THE NOSE CONE IS
PROTECTED BY THE TILES, IT MAY BE THAT THIS ISN'T CONSIDERED TO
BE A CREDIBLE FAILURE. THE NOSE CONE IS ALSO CONSIDERED
STRUCTURE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-101   BASELINE [X]
NASA FMEA #:   SED01-1   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 101
ITEM: PRESSURE PORT (14)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[1 /1]	[ ]	[ ]	[ ]	[X] *
IOA	[1 /1]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[N]

RECOMMENDATIONS: (If different from NASA)

        [/   ]   [   ]   [   ]   [   ]   [   ]
                                               (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                    ADEQUATE   [X]
                                    INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-102   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 102
ITEM: PRESSURE PORT (14)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[/]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[N /N]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

        [3 /3]   [   ]   [   ]   [   ]   [A]
                                                    (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:
THIS IS A CREDIBLE FAILURE WHICH COULD RESULT IN TOTAL LOSS OF
EXPERIMENT DATA.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-103   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 103
ITEM: PRESSURE TRANSDUCERS (28)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

```
          CRITICALITY    REDUNDANCY SCREENS        CIL
             FLIGHT                                ITEM
             HDW/FUNC     A        B        C

   NASA   [   /   ]     [   ]    [   ]    [   ]     [   ] *
   IOA    [ 3 /3  ]     [   ]    [   ]    [   ]     [   ]

COMPARE   [ N /N  ]     [   ]    [   ]    [   ]     [   ]
```

RECOMMENDATIONS: (If different from NASA)

```
          [ 3 /3 ]      [   ]    [   ]    [   ]     [ A ]
                                                 (ADD/DELETE)
```

* CIL RETENTION RATIONALE: (If applicable)
                                    ADEQUATE   [   ]
                                    INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-104   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 104
ITEM: RESISTANCE TEMPERATURE DEVICE (8)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

            CRITICALITY   REDUNDANCY SCREENS   CIL
              FLIGHT   ITEM
            HDW/FUNC   A   B   C

    NASA   [/   ]   [   ]   [   ]   [   ]   [   ] *
     IOA   [3 /3]   [   ]   [   ]   [   ]   [   ]

COMPARE   [N /N]   [   ]   [   ]   [   ]   [   ]

RECOMMENDATIONS: (If different from NASA)

           [3 /3]   [   ]   [   ]   [   ]   [A]
                                                     (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                          INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-105   BASELINE [   ]
NASA FMEA #:   NEW   [   ]

SUBSYSTEM: OEX
MDAC ID: 105
ITEM: RADIOMETER (6)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

             CRITICALITY   REDUNDANCY SCREENS   CIL
               FLIGHT   ITEM
              HDW/FUNC   A   B   C

      NASA   [/   ]   [   ]   [   ]   [   ]   [   ] *
      IOA   [3 /3]   [   ]   [   ]   [   ]   [   ]

COMPARE   [N /N]   [   ]   [   ]   [   ]   [   ]

RECOMMENDATIONS: (If different from NASA)

            [3 /3]   [   ]   [   ]   [   ]   [A]
                                                      (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                          INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-200   BASELINE [X]
NASA FMEA #:   FWFS02-1, SUMS 1, 2, 3, 4   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 200
ITEM: SUMS INSTRUMENT ASSEMBLY

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /1R]	[P]	[NA]	[P]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/N]	[N]	[N]	[N]	[ ]

RECOMMENDATIONS: (If different from NASA)

[3 /3]   [   ]   [   ]   [   ]   [   ]
                                            (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                      ADEQUATE   [   ]
                                      INADEQUATE [   ]
REMARKS:
FWFS02-1 COVERS THE FAILURE AS THE WHOLE INSTRUMENT, WHICH THIS
ANALYSIS ALSO DOES. 1, 2, 3, AND 4 ARE INTERFACE FAILURES
BETWEEN UNIT AND STRUCTURE RESULTING IN SAME LEVEL OF FAILURES.
FMEAS TO THIS LEVEL ARE NOT NEEDED. RECOMMEND DELETING 1, 2, 3,
AND 4 SINCE THEY ARE REDUNDANT FMEAS TO FWFS02-1. THERE IS
NOTHING REDUNDANT ABOUT THE UNIT - THERE IS ONLY ONE. ASSUME IR
CAME FROM POSSIBLE INTERFERENCE WITH NOSE GEAR CAUSING POSSIBLE
VEHICLE DAMAGE AND/OR CREW INJURY.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-201   BASELINE [X]
NASA FMEA #:   FWFS02-2, SUMS-20, 21, 22   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 201
ITEM: SUMS INSTRUMENT ASSEMBLY

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

          [/   ]   [   ]   [   ]   [   ]   [   ]
                                                 (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                      ADEQUATE   [   ]
                                      INADEQUATE [   ]
REMARKS:
THE IOA FMEA ADDRESSES ALL INTERNAL FAILURES OF THE SUMS PACKAGE.
FWFS02-2 ONLY ADDRESSES EXCESSIVE CURRENT-SHORT. SUMS 20, 21,
AND 22 ARE INTERFACE FAILURES.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-202   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 202
ITEM: PRESSURE ORIFICE

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[/]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[N /N]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

        [3 /3]   [   ]   [   ]   [   ]   [A]
                                                 (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                          INADEQUATE [   ]
REMARKS:
IN KEEPING WITH THE LEVEL OF DETAIL OF THE OTHER FMEAS. HOWEVER,
THERE WAS NOT A NASA FMEA ON THIS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-203   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 203
ITEM: INLET SYSTEM

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[/]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[N /N]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

        [3 /3]   [   ]   [   ]   [   ]   [A]
                                                  (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                      ADEQUATE   [   ]
                                      INADEQUATE [   ]
REMARKS:
IN KEEPING WITH THE LEVEL OF DETAIL OF THE OTHER FMEA'S.
HOWEVER, THERE WAS NOT A NASA FMEA ON THIS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-204   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 204
ITEM: INLET SYSTEM

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[/]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[N /N]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

        [3 /3]   [   ]   [   ]   [   ]   [A]
                                                  (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:
IN KEEPING WITH THE LEVEL OF DETAIL OF THE OTHER FMEAS. HOWEVER,
THERE WAS NOT A NASA FMEA ON THIS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-205   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 205
ITEM: INLET SYSTEM

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[/]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[N /N]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[3 /3]   [   ]   [   ]   [   ]   [A]
                                    (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                    ADEQUATE   [   ]
                                    INADEQUATE [   ]

REMARKS:
IN KEEPING WITH THE LEVEL OF DETAIL OF THE OTHER FMEAS. HOWEVER,
THERE WAS NOT A NASA FMEA ON THIS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   ' NASA DATA:
ASSESSMENT ID: OEX-206   BASELINE [X]
NASA FMEA #:   SUMS-5 AND 7   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 206
ITEM: SUMS ION PUMP POWER (FLC-3)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

          [/   ]   [   ]   [   ]   [   ]   [   ]
                                              (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:
SUMS-5 ALSO COVERS INSTRUMENT POWER (SEE OEX-208).

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-207   BASELINE [X]
NASA FMEA #:   SUMS-6   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 207
ITEM: SUMS ION PUMP POWER (FLC-3)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

            CRITICALITY   REDUNDANCY SCREENS   CIL
               FLIGHT   ITEM
              HDW/FUNC   A   B   C

     NASA   [3 /3]   [   ]   [   ]   [   ]   [   ] *
      IOA   [3 /3]   [   ]   [   ]   [   ]   [   ]

  COMPARE   [/   ]   [   ]   [   ]   [   ]   [   ]

RECOMMENDATIONS: (If different from NASA)

           [/   ]   [   ]   [   ]   [   ]   [   ]
                                                     (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                         ADEQUATE   [   ]
                                         INADEQUATE [   ]
REMARKS:
SUMS-6 IS GENERIC FOR ANY SHORT IN THE PACKAGE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-208   BASELINE [X]
NASA FMEA #:   SUMS-5, 7 AND 19   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 208
ITEM: SUMS INSTRUMENT POWER (FLC-3)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

        [/   ]   [   ]   [   ]   [   ]   [   ]
                                                (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:
SUMS-5 ALSO COVERS ION PUMP POWER (SEE OEX-206).

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-209   BASELINE [X]
NASA FMEA #:   SUMS-6   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 209
ITEM: SUMS INSTRUMENT POWER (FLC-3)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

            CRITICALITY   REDUNDANCY SCREENS   CIL
               FLIGHT   ITEM
             HDW/FUNC   A   B   C

   NASA   [3 /3]   [   ]   [   ]   [   ]   [   ] *
   IOA   [3 /3]   [   ]   [   ]   [   ]   [   ]

COMPARE   [/   ]   [   ]   [   ]   [   ]   [   ]

RECOMMENDATIONS: (If different from NASA)

           [/   ]   [   ]   [   ]   [   ]   [   ]
                                                     (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                         ADEQUATE   [   ]
                                         INADEQUATE [   ]

REMARKS:
SUMS-6 IS GENERIC FOR ANY SHORT IN THE PACKAGE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-210   BASELINE [X]
NASA FMEA #:   SUMS-8 AND 15   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 210
ITEM: SUMS VACUUM MAINTENANCE POWER (FLC-3)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

             CRITICALITY   REDUNDANCY SCREENS   CIL
                FLIGHT   ITEM
              HDW/FUNC   A   B   C

     NASA   [3 /3]   [   ]   [   ]   [   ]   [   ] *
      IOA   [3 /3]   [   ]   [   ]   [   ]   [   ]

COMPARE   [/   ]   [   ]   [   ]   [   ]   [   ]

RECOMMENDATIONS: (If different from NASA)

           [/   ]   [   ]   [   ]   [   ]   [   ]
                                                       (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                          INADEQUATE [   ]
REMARKS:
SUMS-8 AND 15 ARE REDUNDANT FMEAS; ONE COULD BE DELETED.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-211   BASELINE [   ]
NASA FMEA #:   SUMS-6   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 211
ITEM: SUMS VACUUM MAINTENANCE POWER (FLC-3)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

              CRITICALITY   REDUNDANCY SCREENS   CIL
                 FLIGHT   ITEM
               HDW/FUNC   A   B   C

      NASA   [3 /3]   [   ]   [   ]   [   ]   [   ] *
      IOA   [3 /3]   [   ]   [   ]   [   ]   [   ]

COMPARE   [/   ]   [   ]   [   ]   [   ]   [   ]

RECOMMENDATIONS: (If different from NASA)

            [/   ]   [   ]   [   ]   [   ]   [   ]
                                                      (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]

REMARKS:
SUMS-6 IS GENERIC FOR ANY SHORT IN THE PACKAGE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87
ASSESSMENT ID: OEX-212
NASA FMEA #:   SUMS-9

NASA DATA:
  BASELINE [X]
    NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 212
ITEM: PCM TO SUMS COMM. - PCM CLOCK

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

    [/   ]   [   ]   [   ]   [   ]   [   ]
                                   (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                            ADEQUATE   [   ]
                          INADEQUATE [   ]

REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-213   BASELINE [X]
NASA FMEA #:   SUMS-10   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 213
ITEM: PCM TO SUMS COMM. - DATA STROBE

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

         [/]   [   ]   [   ]   [   ]   [   ]
                                                 (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                          INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-214   BASELINE [X]
NASA FMEA #:   SUMS-11, 12, 16 AND 18   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 214
ITEM: SUMS TO PCM COMM. - DIGITAL DATA

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

        [/   ]   [   ]   [   ]   [   ]   [   ]
                                                    (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                          INADEQUATE [   ]
REMARKS:
NASA FMEAS WERE WRITTEN TO COVER THE EXCHANGE OF DIGITAL DATA
THROUGH EACH PATH. THIS FMEA LUMPED THEM ALL TOGETHER.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-215   BASELINE [X]
NASA FMEA #:   SUMS-13, 14 AND 17   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 215
ITEM: SUMS TO PCM COMM. - ANALOG DATA

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/   ]   [   ]   [   ]   [   ]   [   ]
                                                      (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                     ADEQUATE   [   ]
                                   INADEQUATE   [   ]

REMARKS:
NASA FMEAS WERE WRITTEN TO COVER THE EXCHANGE OF ANALOG DATA
THROUGH EACH PATH. THIS FMEA LUMPED THEM ALL TOGETHER.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-300   BASELINE [X]
NASA FMEA #:   FWFS01-1   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 300
ITEM: PULSE CODE MODULATOR - SLAVE #2

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS			CIL ITEM
		A	B	C	
NASA	[3 /1R]	[P]	[NA]	[P]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/N]	[N]	[N]	[N]	[ ]

RECOMMENDATIONS: (If different from NASA)

       [3 /3]   [   ]   [   ]   [   ]   [   ]
                                                  (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:
PCM SLAVE IS NOT REDUNDANT. ASSUME 1R CRITICALITY CAME FROM
POSSIBLE INTERFERENCE WITH NOSE GEAR DEPLOYMENT.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-301   BASELINE [   ]
NASA FMEA #:   NEW   [   ]

SUBSYSTEM: OEX
MDAC ID: 301
ITEM: PULSE CODE MODULATOR - SLAVE #2

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[/]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[N /N]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[3 /3]   [   ]   [   ]   [   ]   [A]
                                             (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                    ADEQUATE   [   ]
                                    INADEQUATE [   ]
REMARKS:
NASA DID NOT ADDRESS INTERNAL FAILURE OF UNIT.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-302   BASELINE [X]
NASA FMEA #:   FWFS03-1   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 302
ITEM: STATIC PRESSURE TRANSDUCER (12)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

```
              CRITICALITY      REDUNDANCY SCREENS              CIL
                 FLIGHT                                        ITEM
               HDW/FUNC      A          B          C

       NASA  [ 3 /3 ]     [   ]      [   ]      [   ]        [   ] *
        IOA  [ 3 /3 ]     [   ]      [   ]      [   ]        [   ]

COMPARE      [   /   ]     [   ]      [   ]      [   ]        [   ]
```

RECOMMENDATIONS: (If different from NASA)

```
             [   /   ]    [   ]     [   ]      [   ]         [   ]
                                                          (ADD/DELETE)
```

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-303   BASELINE [   ]
NASA FMEA #:   NEW   [   ]

SUBSYSTEM: OEX
MDAC ID: 303
ITEM: RESISTANCE TEMPERATURE DEVICE (7)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

```
           CRITICALITY      REDUNDANCY SCREENS        CIL
              FLIGHT                                  ITEM
            HDW/FUNC       A        B        C

   NASA   [   /   ]     [   ]    [   ]    [   ]     [   ] *
    IOA   [ 3 /3  ]     [   ]    [   ]    [   ]     [   ]

COMPARE   [ N /N  ]     [   ]    [   ]    [   ]     [   ]
```

RECOMMENDATIONS: (If different from NASA)

```
          [ 3 /3  ]     [   ]    [   ]    [   ]        [ A ]
                                                   (ADD/DELETE)
```

* CIL RETENTION RATIONALE: (If applicable)
                                       ADEQUATE   [   ]
                                       INADEQUATE [   ]

REMARKS:
THERE ARE NO NASA FMEAS ON THE RTDS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-304   BASELINE [X]
NASA FMEA #:   FWFS04-1   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 304
ITEM: TEMPERATURE SIGNAL CONDITIONER (8)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

        [/   ]   [   ]   [   ]   [   ]   [   ]
                                                 (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                          INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-400   BASELINE [X]
NASA FMEA #:   (SEE REMARKS)   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 400
ITEM: PRESSURE SYSTEM AND DCM MOUNT

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

         [/]   [ ]   [ ]   [ ]   [ ]
                                              (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]

REMARKS:
FMEA: PRESSURE 1, 2, 5, 10, 15, 18, 22; PRESSURE WINDOW 2, 4, 6;
PRESSURE (PIN PULLERS) 1, 3; DCM STRUCTURE 1, 4; DOME ASSY 12;
DOME ASSY (BULKHEAD ASSY) 1, 2, 3, 4, 5, 6, 7.
NASA FMEAS COVER SUPPORT STRUCTURES, THEN BREAKDOWN MOUNTS AND
SUPPORTS INTO SMALLER PIECES. THIS FMEA COMBINES ALL THESE
PIECES INTO ONE GENERAL CATEGORY SINCE THE CRITICALITY IS THE
SAME. OTHER OEX EXPERIMENT HARDWARE WAS NOT BROKEN DOWN TO THIS
LEVEL ON THE NASA FMEAS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-401   BASELINE [X]
NASA FMEA #:   PRESSURE 4   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 401
ITEM: GN2 TANKS

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/   ]   [   ]   [   ]   [   ]   [   ]
                                         (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                    ADEQUATE   [   ]
                                    INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-402   BASELINE [X]
NASA FMEA #:   PRESSURE 6   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 402
ITEM: FILL VALVE

LEAD ANALYST: J. COMPTON

ASSESSMENT:

```
            CRITICALITY    REDUNDANCY SCREENS          CIL
              FLIGHT                                   ITEM
              HDW/FUNC      A          B          C

      NASA  [ 3 /3 ]     [   ]     [   ]      [   ]       [   ] *
      IOA   [ 3 /3 ]     [   ]     [   ]      [   ]       [   ]

COMPARE    [   /   ]     [   ]     [   ]      [   ]       [   ]
```

RECOMMENDATIONS: (If different from NASA)

```
           [   /   ]     [   ]    [   ]    [   ]          [   ]
                                                   (ADD/DELETE)
```

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-403   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 403
ITEM: RUPTURE DISK

LEAD ANALYST: J. COMPTON

ASSESSMENT:

            CRITICALITY   REDUNDANCY SCREENS   CIL
               FLIGHT   ITEM
             HDW/FUNC   A   B   C

     NASA [/   ]   [   ]   [   ]   [   ]   [   ] *
     IOA   [3 /3]   [   ]   [   ]   [   ]   [   ]

COMPARE   [N /N]   [   ]   [   ]   [   ]   [   ]

RECOMMENDATIONS: (If different from NASA)

           [3 /3]   [   ]   [   ]   [   ]   [A]
                                                    (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                            ADEQUATE   [   ]
                                          INADEQUATE   [   ]
REMARKS:
NASA FMEA ONLY ADDRESSES IF DISK LOSSES PRESSURE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-404   BASELINE [X]
NASA FMEA #:   PRESSURE 7   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 404
ITEM: RUPTURE DISK

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/   ]   [   ]   [   ]   [   ]   [   ]
                                       (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                    ADEQUATE   [   ]
                                    INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-405   BASELINE [X]
NASA FMEA #:   PRESSURE 8   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 405
ITEM: FILTER

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

         [/   ]   [   ]   [   ]   [   ]   [   ]
                                                 (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-406   BASELINE [X]
NASA FMEA #:   PRESSURE 9   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 406
ITEM: LATCHING SOLENOID VALVE

LEAD ANALYST: J. COMPTON

ASSESSMENT:

```
              CRITICALITY      REDUNDANCY SCREENS          CIL
                FLIGHT                                     ITEM
               HDW/FUNC        A         B         C

        NASA  [ 3 /3 ]      [   ]     [   ]     [   ]      [   ] *
         IOA  [ 3 /3 ]      [   ]     [   ]     [   ]      [   ]

     COMPARE  [   /   ]     [   ]     [   ]     [   ]      [   ]
```

RECOMMENDATIONS: (If different from NASA)

```
              [   /   ]     [   ]     [   ]     [   ]      [   ]
                                                         (ADD/DELETE)
```

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]

REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-407   BASELINE [X]
NASA FMEA #: PRESSURE 11   NEW [ ]

SUBSYSTEM: OEX
MDAC ID: 407
ITEM: CHECK VALVE

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

   [/] [ ] [ ] [ ]   [ ]
                 (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
             ADEQUATE [ ]
            INADEQUATE [ ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-408   BASELINE [X]
NASA FMEA #:   PRESSURE 14   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 408
ITEM: FILTER

LEAD ANALYST: J. COMPTON

ASSESSMENT:

```
             CRITICALITY      REDUNDANCY SCREENS        CIL
                FLIGHT                                  ITEM
             HDW/FUNC      A         B         C

    NASA  [ 3 /3 ]      [   ]     [   ]     [   ]      [   ] *
     IOA  [ 3 /3 ]      [   ]     [   ]     [   ]      [   ]

COMPARE   [   /   ]     [   ]     [   ]     [   ]      [   ]
```

RECOMMENDATIONS: (If different from NASA)

```
          [   /   ]     [   ]     [   ]     [   ]       [   ]
                                                     (ADD/DELETE)
```

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                        INADEQUATE   [   ]
REMARKS:

REPORT DATE 02/05/88   C-37

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-409   BASELINE [X]
NASA FMEA #:   PRESSURE 16   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 409
ITEM: CHECK VALVE

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

         [/   ]   [   ]   [   ]   [   ]   [   ]
                                                  (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-410   BASELINE [X]
NASA FMEA #:   PRESSURE 17   NEW   [   ]

SUBSYSTEM: OEX
MDAC ID: 410
ITEM: CHECK VALVES

LEAD ANALYST: J. COMPTON

ASSESSMENT:

```
            CRITICALITY      REDUNDANCY SCREENS          CIL
               FLIGHT                                    ITEM
              HDW/FUNC       A        B        C

      NASA  [ 3 /3 ]      [   ]    [   ]    [   ]      [   ] *
       IOA  [ 3 /3 ]      [   ]    [   ]    [   ]      [   ]

   COMPARE  [   /  ]      [   ]    [   ]    [   ]      [   ]
```

RECOMMENDATIONS: (If different from NASA)

```
          [   /  ]      [   ]    [   ]    [   ]        [   ]
                                                   (ADD/DELETE)
```

* CIL RETENTION RATIONALE: (If applicable)
                                      ADEQUATE   [   ]
                                      INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-411   BASELINE [X]
NASA FMEA #:   PRESSURE 20   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 411
ITEM: FILTER

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

        [/   ]   [   ]   [   ]   [   ]   [   ]
                                                (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                    ADEQUATE   [   ]
                                    INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-412   BASELINE [X]
NASA FMEA #:   PRESSURE 21   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 412
ITEM: PRESSURE REDUCTION COIL

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

        [/   ]   [   ]   [   ]   [   ]   [   ]
                                              (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-413   BASELINE [X]
NASA FMEA #:   PRESSURE 21   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 413
ITEM: PRESSURE REDUCTION COIL

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

           [/   ]   [   ]   [   ]   [   ]   [   ]
                                                      (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                          INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-415   BASELINE [X]
NASA FMEA #:   PRESSURE (WINDOW) 1   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 415
ITEM: ORIFICES

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

            [/   ]   [   ]   [   ]   [   ]   [   ]
                                                      (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                    ADEQUATE   [   ]
                                    INADEQUATE [   ]

REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-416   BASELINE [X]
NASA FMEA #:   PRESSURE (PIN PULLER) 4   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 416
ITEM: PIN PULLERS

LEAD ANALYST: J. COMPTON

ASSESSMENT:

```
          CRITICALITY      REDUNDANCY SCREENS          CIL
             FLIGHT                                     ITEM
           HDW/FUNC       A        B        C

   NASA  [ 3 /3 ]     [   ]    [   ]    [   ]      [   ] *
    IOA  [ 3 /3 ]     [   ]    [   ]    [   ]      [   ]

COMPARE  [   /   ]    [   ]    [   ]    [   ]      [   ]
```

RECOMMENDATIONS: (If different from NASA)

```
          [   /   ]    [   ]    [   ]    [   ]        [   ]
                                                   (ADD/DELETE)
```

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-417   BASELINE [X]
NASA FMEA #: (SEE REMARKS)   NEW [ ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 417
ITEM: HEATER SWITCH, SILTS

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

  [/   ] [   ] [   ] [   ] [   ]
               (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
           ADEQUATE [   ]
          INADEQUATE [   ]

REMARKS:
FMEA: PRESSURE 3, DCM STRUCTURE 5.
NASA FMEAS FOR THERMAL CONTROL OF PRESSURE SYSTEM AND DCM; DOES
NOT COVER THIS SWITCH SPECIFICALLY.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-418   BASELINE [X]
NASA FMEA #:   (SEE REMARKS)   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 418
ITEM: THERMOSTAT (3)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

       [/   ]   [   ]   [   ]   [   ]   [   ]
                                                (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                      INADEQUATE   [   ]
REMARKS:
FMEA: PRESSURE 9; DCM STRUCTURE 5; DCM ELECTRONICS 1, 2, 3; DOME
ASSY 9.
INCLUDES NASA FMEAS ON THERMAL CONTROL PLUS SPECIFIC FMEAS ON
THERMOSTATS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-419   BASELINE [X]
NASA FMEA #:   (SEE REMARKS)   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 419
ITEM: HEATERS (3)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

```
           CRITICALITY    REDUNDANCY SCREENS          CIL
             FLIGHT                                    ITEM
            HDW/FUNC       A        B        C

   NASA   [ 3 /3 ]      [   ]    [   ]    [   ]      [   ] *
    IOA   [ 3 /3 ]      [   ]    [   ]    [   ]      [   ]

COMPARE   [   /   ]     [   ]    [   ]    [   ]      [   ]
```

RECOMMENDATIONS: (If different from NASA)

```
          [   /   ]     [   ]    [   ]    [   ]        [     ]
                                                    (ADD/DELETE)
```

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                          INADEQUATE [   ]
REMARKS:
FMEA: PRESSURE 3; DCM STRUCTURE 5; DCM ELECTRONICS 4, 5, 6; DOME
ASSY 9; DOME ASSY (BLACK BODY ASSY) 1.
INCLUDES NASA FMEAS ON THERMAL CONTROL PLUS SPECIFIC FMEAS ON
HEATERS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-420   BASELINE [X]
NASA FMEA #:   (SEE REMARKS)   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 420
ITEM: DATA CONTROL MODULE (DCM)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

            CRITICALITY   REDUNDANCY SCREENS   CIL
               FLIGHT   ITEM
            HDW/FUNC   A   B   C

     NASA [3 /3]   [   ]   [   ]   [   ]   [   ] *
      IOA [3 /3]   [   ]   [   ]   [   ]   [   ]

COMPARE   [/   ]   [   ]   [   ]   [   ]   [   ]

RECOMMENDATIONS: (If different from NASA)

          [/   ]   [   ]   [   ]   [   ]   [   ]
                                                   (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:
FMEA: DCM STRUCTURE 2, 3; DCM ELECTRONICS 8, 9, 10, 11, 12, 13,
14, 15, 16.
NASA FMEAS WENT INSIDE BOX AND ITS INTERFACES. THIS LEVEL OF
DETAIL NOT REQUIRED SINCE CRITICALITY IS 3/3 FOR WHOLE MODULE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-421   BASELINE [X]
NASA FMEA #:   DCM ELECTRONICS 7   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 421
ITEM: SOLENOID RELAY, DCM

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS			CIL ITEM
		A	B	C	
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/]   [   ]   [   ]   [   ]   [   ]
                                      (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                              ADEQUATE   [   ]
                              INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-422   BASELINE [X]
NASA FMEA #:   DCM ELECTRONICS 7   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 422
ITEM: SOLENOID RELAY, DCM

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

        [/   ]   [   ]   [   ]   [   ]   [   ]
                                                (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                    ADEQUATE   [   ]
                                    INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-423   BASELINE [X]
NASA FMEA #:   (SEE REMARKS)   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 423
ITEM: WINDOW ASSEMBLY

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

         [/   ]   [   ]   [   ]   [   ]   [   ]
                                              (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                       ADEQUATE   [   ]
                                       INADEQUATE [   ]
REMARKS:
PRESSURE WINDOW 3, 5, 7; PRESSURE (PIN PULLERS) 2, 5; DOME ASSY
1, 2; DOME (WINDOW ASSY) 1, 2, 3, 4, 5, 6, 8, 9.
THIS FMEA ADDRESSES THE COMPLETE WINDOW ASSY AND ITS INTERFACES
AS A WHOLE. THERE ARE A LOT OF NASA FMEAS WHICH GO BELOW THIS
LEVEL, BUT ALL THE CRITICALITIES ARE 3/3. THIS LEVEL OF DETAIL
NOT CONSISTENT WITH OTHER OEX EXPERIMENTS.

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-424   BASELINE [X]
NASA FMEA #:   (SEE REMARKS)   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 424
ITEM: CAMERA ASSEMBLY

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS			CIL ITEM
		A	B	C	
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

      [/   ]   [   ]   [   ]   [   ]   [   ]
                                              (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:
FMEA: PRESSURE 19; DOME ASSY 3, 4, 5, 6, 7, 8, 10, 13; DOME ASSY
(CAMERA POINT MECH.) 1, 2, 3, 4, 5.
THIS FMEA ADDRESSES THE COMPLETE CAMERA ASSEMBLY AND ITS
INTERFACES AS A WHOLE.   THERE ARE A LOT OF NASA FMEAS WHICH GO
BELOW THIS LEVEL, BUT ALL THE CRITICALITIES ARE 3/3.   THIS LEVEL
OF DETAIL NOT CONSISTENT WITH OTHER OEX EXPERIMENTS.

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-425   BASELINE [X]
NASA FMEA #:   (SEE REMARKS)   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 425
ITEM: BLACKBODY ASSEMBLY

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS			CIL ITEM
		A	B	C	
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/   ]   [   ]   [   ]   [   ]   [   ]
                                        (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                    ADEQUATE   [   ]
                                    INADEQUATE [   ]
REMARKS:
FMEA: DOME ASSY 11; DOME ASSY (BLACK BODY ASSY) 1, 2, 3, 4, 5,
6, 7.
NASA HAS ONE FMEA AT THIS LEVEL, THEN SEVEN MORE FMEAS AT GREATER
DETAIL. OVER ALL CRITICALITY IS 3/3; THUS GREATER DETAIL NOT
REQUIRED NOR CONSISTENT WITH OTHER OEX EXPERIMENTS.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-426   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 426
ITEM: SILTS ENABLE SWITCH

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[/]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[N /N]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

         [3 /3]   [   ]   [   ]   [   ]   [A]
                                                    (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:
NO NASA FMEA EXISTS ON THIS SWITCH.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-500   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 500
ITEM: TRIAXIAL ACCELEROMETER/GYRO INSTRUMENT PACKAGE

LEAD ANALYST: J. COMPTON

ASSESSMENT:

```
          CRITICALITY      REDUNDANCY SCREENS          CIL
            FLIGHT                                      ITEM
            HDW/FUNC      A        B        C

  NASA    [  /  ]      [   ]    [   ]    [   ]       [   ] *
   IOA    [ 3 /3 ]     [   ]    [   ]    [   ]       [   ]

COMPARE   [ N /N ]     [   ]    [   ]    [   ]       [   ]
```

RECOMMENDATIONS: (If different from NASA)

```
          [ 3 /3 ]     [   ]    [   ]    [   ]       [ A ]
                                                   (ADD/DELETE)
```

* CIL RETENTION RATIONALE: (If applicable)
                                         ADEQUATE   [   ]
                                       INADEQUATE   [   ]
REMARKS:
NASA FMEAS ONLY ADDRESSED INTERFACES, NOT ACTUAL HARDWARE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-501   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 501
ITEM: TRIAXIAL ANGULAR ACCELEROMETER

LEAD ANALYST: J. COMPTON

ASSESSMENT:

```
           CRITICALITY      REDUNDANCY SCREENS           CIL
              FLIGHT                                     ITEM
             HDW/FUNC      A         B         C

    NASA   [   /   ]    [   ]     [   ]     [   ]      [   ] *
     IOA   [ 3 /3  ]    [   ]     [   ]     [   ]      [   ]

COMPARE    [ N /N  ]    [   ]     [   ]     [   ]      [   ]
```

RECOMMENDATIONS: (If different from NASA)

```
           [ 3 /3  ]    [   ]     [   ]     [   ]      [ A ]
                                                    (ADD/DELETE)
```

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                        INADEQUATE   [   ]
REMARKS:
NASA FMEAS ONLY ADDRESSED INTERFACES, NOT ACTUAL HARDWARE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-502   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 502
ITEM: TRIAXIAL VIBRATION SENSOR

LEAD ANALYST: J. COMPTON

ASSESSMENT:

```
           CRITICALITY      REDUNDANCY SCREENS           CIL
              FLIGHT                                      ITEM
            HDW/FUNC       A          B          C

   NASA   [   /   ]     [    ]    [    ]     [    ]      [    ] *
    IOA   [ 3 /3  ]     [    ]    [    ]     [    ]      [    ]

COMPARE   [ N /N  ]     [    ]    [    ]     [    ]      [    ]
```

RECOMMENDATIONS: (If different from NASA)

```
          [ 3 /3 ]      [    ]    [    ]     [    ]        [ A ]
                                                      (ADD/DELETE)
```

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:
NASA FMEAS ONLY ADDRESSED INTERFACES, NOT ACTUAL HARDWARE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-503   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 503
ITEM: HIGH RESOLUTION LINEAR ACCELEROMETER PACKAGE

LEAD ANALYST: J. COMPTON

ASSESSMENT:

```
          CRITICALITY    REDUNDANCY SCREENS          CIL
             FLIGHT                                  ITEM
           HDW/FUNC      A        B        C

   NASA   [   /   ]    [   ]    [   ]    [   ]     [   ] *
    IOA   [ 3 /3  ]    [   ]    [   ]    [   ]     [   ]

COMPARE   [ N /N  ]    [   ]    [   ]    [   ]     [   ]
```

RECOMMENDATIONS: (If different from NASA)

```
        [ 3 /3 ]      [   ]    [   ]    [   ]        [ A ]
                                                  (ADD/DELETE)
```

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:
NASA FMEAS ONLY ADDRESSED INTERFACES, NOT ACTUAL HARDWARE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-504   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 504
ITEM: DATA HANDLING ELECTRONICS

LEAD ANALYST: J. COMPTON

ASSESSMENT:

            CRITICALITY   REDUNDANCY SCREENS   CIL
              FLIGHT   ITEM
            HDW/FUNC   A   B   C

    NASA   [/   ]   [   ]   [   ]   [   ]   [   ] *
     IOA   [3 /3]   [   ]   [   ]   [   ]   [   ]

COMPARE   [N /N]   [   ]   [   ]   [   ]   [   ]

RECOMMENDATIONS: (If different from NASA)

            [3 /3]   [   ]   [   ]   [   ]   [A]
                                                      (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                          INADEQUATE [   ]
REMARKS:
NASA FMEAS ONLY ADDRESSED INTERFACES, NOT ACTUAL HARDWARE.

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-505   BASELINE [   ]
NASA FMEA #:   NEW   [   ]

SUBSYSTEM: OEX
MDAC ID: 505
ITEM: MINI DATA HANDLING ELECTRONICS

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[/]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[N /N]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

          [3 /3]   [   ]   [   ]   [   ]   [A]
                                                          (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                              ADEQUATE   [   ]
                                              INADEQUATE [   ]
REMARKS:
NASA FMEAS ONLY ADDRESSED INTERFACES, NOT ACTUAL HARDWARE.

ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-506   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 506
ITEM: PCM SLAVE

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[/]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[N /N]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

           [3 /3]   [   ]   [   ]   [   ]   [A]
                                                   (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:
NASA FMEAS ONLY ADDRESSED INTERFACES, NOT ACTUAL HARDWARE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-507   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 507
ITEM: PCM MASTER

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS			CIL ITEM
		A	B	C	
NASA	[/]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[N /N]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[3 /3]	[ ]	[ ]	[ ]	[A]
				(ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                            ADEQUATE   [   ]
                                            INADEQUATE [   ]
REMARKS:
NASA FMEAS ONLY ADDRESSED INTERFACES, NOT ACTUAL HARDWARE.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87
ASSESSMENT ID: OEX-508
NASA FMEA #:   ACIP06-1

NASA DATA:
BASELINE [X]
NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 508
ITEM: PAYLOAD TIMING BUFFER GMT #8

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/   ]   [   ]   [   ]   [   ]   [   ]
(ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE   [   ]
INADEQUATE [   ]

REMARKS:

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-509   BASELINE [X]
NASA FMEA #:   ACIP01-1   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 509
ITEM: ISOLATION DIODE-ACIP ON CMD

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

             [/   ]   [   ]   [   ]   [   ]   [   ]
                                                              (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                           ADEQUATE   [   ]
                                           INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-510   BASELINE [X]
NASA FMEA #:   ACIP01-2   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 510
ITEM: ISOLATION DIODE-ACIP ON CMD

LEAD ANALYST: J. COMPTON

ASSESSMENT:

        CRITICALITY   REDUNDANCY SCREENS   CIL
           FLIGHT   ITEM
          HDW/FUNC   A   B   C

    NASA [3 /3]   [   ]   [   ]   [   ]   [   ] *
     IOA [3 /3]   [   ]   [   ]   [   ]   [   ]

COMPARE   [/]   [   ]   [   ]   [   ]   [   ]

RECOMMENDATIONS: (If different from NASA)

          [/]   [   ]   [   ]   [   ]   [   ]
                                                 (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                          INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-511   BASELINE [X]
NASA FMEA #:   ACIP02-1   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 511
ITEM: REMOTE POWER CONTROLLER-42

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS			CIL ITEM	
		A	B	C		
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ]	*
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]	
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]	

RECOMMENDATIONS: (If different from NASA)

          [/   ]   [   ]   [   ]   [   ]   [   ]
                                                (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                          INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-512   BASELINE [X]
NASA FMEA #:   ACIP02-2   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 512
ITEM: REMOTE POWER CONTROLLER-42

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

   [/   ]   [   ]   [   ]   [   ]   [   ]
                                            (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-513   BASELINE [X]
NASA FMEA #:   ACIP03-1   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 513
ITEM: RESISTOR

LEAD ANALYST: J. COMPTON

ASSESSMENT:

                CRITICALITY   REDUNDANCY SCREENS   CIL
                   FLIGHT   ITEM
                 HDW/FUNC   A   B   C

        NASA   [3 /3]   [   ]   [   ]   [   ]   [   ] *
         IOA   [3 /3]   [   ]   [   ]   [   ]   [   ]

COMPARE   [/   ]   [   ]   [   ]   [   ]   [   ]

RECOMMENDATIONS: (If different from NASA)

          [/   ]   [   ]   [   ]   [   ]   [   ]
                                                          (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                           ADEQUATE   [   ]
                                           INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-514   BASELINE [X]
NASA FMEA #:   ACIP04-1   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 514
ITEM: ACIP HEATER SWITCH

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

          [/   ]   [   ]   [   ]   [   ]   [   ]
                                                    (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-515   BASELINE [X]
NASA FMEA #:   ACIP04-2   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 515
ITEM: ACIP HEATER SWITCH

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS			CIL ITEM
		A	B	C	
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

          [/   ]   [   ]   [   ]   [   ]   [   ]
                                                 (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87
ASSESSMENT ID: OEX-516
NASA FMEA #:   ACIP05-1

NASA DATA:
BASELINE [X]
NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 516
ITEM: REMOTE POWER CONTROLLER-41

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/   ]   [   ]   [   ]   [   ]   [   ]
(ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)

ADEQUATE   [   ]
INADEQUATE   [   ]

REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-517   BASELINE [X]
NASA FMEA #:   ACIP05-2   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 517
ITEM: REMOTE POWER CONTROLLER-41

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

           [/]   [   ]   [   ]   [   ]   [   ]
                                                (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                          INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-518   BASELINE [X]
NASA FMEA #:   ACIP14-1   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 518
ITEM: HYBRID DRIVER

LEAD ANALYST: J. COMPTON

ASSESSMENT:

            CRITICALITY   REDUNDANCY SCREENS   CIL
              FLIGHT   ITEM
            HDW/FUNC   A   B   C

     NASA   [3 /3]   [   ]   [   ]   [   ]   [   ] *
      IOA   [3 /3]   [   ]   [   ]   [   ]   [   ]

  COMPARE   [/   ]   [   ]   [   ]   [   ]   [   ]

RECOMMENDATIONS: (If different from NASA)

           [/   ]   [   ]   [   ]   [   ]   [   ]
                                                      (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                          INADEQUATE [   ]
REMARKS:

REPORT DATE 02/05/88   C-73

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-519   BASELINE [X]
NASA FMEA #:   ACIP14-2   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 519
ITEM: HYBRID DRIVER

LEAD ANALYST: J. COMPTON

ASSESSMENT:

```
            CRITICALITY      REDUNDANCY SCREENS          CIL
               FLIGHT                                    ITEM
             HDW/FUNC       A        B        C

   NASA    [ 3 /3 ]      [   ]    [   ]    [   ]      [   ] *
    IOA    [ 3 /3 ]      [   ]    [   ]    [   ]      [   ]

COMPARE    [   /   ]     [   ]    [   ]    [   ]      [   ]
```

RECOMMENDATIONS: (If different from NASA)

```
           [   /   ]     [   ]    [   ]    [   ]          [   ]
                                                     (ADD/DELETE)
```

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:

ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-520   BASELINE [X]
NASA FMEA #:   ACIP12-1   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 520
ITEM: ISOLATION DIODE-ACIP CALIB

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

          [/   ]   [   ]   [   ]   [   ]   [   ]
                                                (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                      ADEQUATE   [   ]
                                      INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-521   BASELINE [X]
NASA FMEA #:   ACIP12-2   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 521
ITEM: ISOLATION DIODE-ACIP CALIB

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

          [/   ]   [   ]   [   ]   [   ]   [   ]
                                                    (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                      ADEQUATE   [   ]
                                      INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-600   BASELINE [X]
NASA FMEA #:   ACIP07-1   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 600
ITEM: OEX RECORDER

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

[/   ]   [   ]   [   ]   [   ]   [   ]
                                        (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                      ADEQUATE   [   ]
                                      INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-601   BASELINE [X]
NASA FMEA #:   ACIP10-1   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 601
ITEM: HYBRID RELAY

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

        [/]   [   ]   [   ]   [   ]   [   ]
                                                  (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]
REMARKS:

ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-602   BASELINE [X]
NASA FMEA #:   ACIP10-2   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 602
ITEM: HYBRID RELAY

LEAD ANALYST: J. COMPTON

ASSESSMENT:

```
          CRITICALITY     REDUNDANCY SCREENS          CIL
             FLIGHT                                    ITEM
            HDW/FUNC       A        B        C

    NASA   [ 3 /3 ]      [   ]    [   ]    [   ]      [   ] *
     IOA   [ 3 /3 ]      [   ]    [   ]    [   ]      [   ]

COMPARE    [   /  ]      [   ]    [   ]    [   ]      [   ]
```

RECOMMENDATIONS: (If different from NASA)

```
           [   /  ]      [   ]    [   ]    [   ]          [   ]
                                                     (ADD/DELETE)
```

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                      INADEQUATE   [   ]

REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-603   BASELINE [X]
NASA FMEA #:   ACIP11-1   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 603
ITEM: ISOLATION DIODE-OEX PCM/RCDR ON

LEAD ANALYST: J. COMPTON

ASSESSMENT:

```
             CRITICALITY      REDUNDANCY SCREENS           CIL
                FLIGHT                                      ITEM
              HDW/FUNC      A          B          C

      NASA  [ 3 /3 ]      [   ]     [   ]      [   ]      [   ] *
      IOA   [ 3 /3 ]      [   ]     [   ]      [   ]      [   ]

COMPARE     [   /   ]     [   ]     [   ]      [   ]      [   ]
```

RECOMMENDATIONS: (If different from NASA)

```
            [   /   ]     [   ]     [   ]      [   ]          [   ]
                                                          (ADD/DELETE)
```

* CIL RETENTION RATIONALE: (If applicable)
                                            ADEQUATE   [   ]
                                            INADEQUATE [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-604   BASELINE [X]
NASA FMEA #:   ACIP11-2   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 604
ITEM: ISOLATION DIODE-OEX PCM/RCDR ON

LEAD ANALYST: J. COMPTON

ASSESSMENT:

             CRITICALITY   REDUNDANCY SCREENS   CIL
               FLIGHT   ITEM
              HDW/FUNC   A   B   C

   NASA   [3 /3]   [   ]   [   ]   [   ]   [   ] *
    IOA   [3 /3]   [   ]   [   ]   [   ]   [   ]

COMPARE   [/   ]   [   ]   [   ]   [   ]   [   ]

RECOMMENDATIONS: (If different from NASA)

           [/   ]   [   ]   [   ]   [   ]   [   ]
                                                       (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                        ADEQUATE   [   ]
                                        INADEQUATE [   ]

REMARKS:

REPORT DATE 02/05/88   C-81

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-605   BASELINE [X]
NASA FMEA #:   ACIP13-1   NEW [   ]

SUBSYSTEM: OEX/EPD&C
MDAC ID: 605
ITEM: RESISTOR

LEAD ANALYST: J. COMPTON

ASSESSMENT:

	CRITICALITY FLIGHT HDW/FUNC	REDUNDANCY SCREENS A	B	C	CIL ITEM
NASA	[3 /3]	[ ]	[ ]	[ ]	[ ] *
IOA	[3 /3]	[ ]	[ ]	[ ]	[ ]
COMPARE	[/]	[ ]	[ ]	[ ]	[ ]

RECOMMENDATIONS: (If different from NASA)

        [/]   [   ]   [   ]   [   ]   [   ]
                                                 (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                        INADEQUATE   [   ]
REMARKS:

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-606   BASELINE [   ]
NASA FMEA #:   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 606
ITEM: TRANSDUCERS, SENSORS (INSTRUMENTATION)

LEAD ANALYST: J. COMPTON

ASSESSMENT:

            CRITICALITY   REDUNDANCY SCREENS   CIL
               FLIGHT   ITEM
            HDW/FUNC   A   B   C

    NASA   [/   ]   [   ]   [   ]   [   ]   [   ] *
     IOA   [3 /3]   [   ]   [   ]   [   ]   [   ]

COMPARE   [N /N]   [   ]   [   ]   [   ]   [   ]

RECOMMENDATIONS: (If different from NASA)

           [3 /3]   [   ]   [   ]   [   ]   [A]
                                                        (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                            ADEQUATE   [   ]
                                          INADEQUATE   [   ]
REMARKS:
THERE ARE NO NASA FMEAS COVERING THE INSTRUMENTATION SENSORS FOR
THE OEX. ALL SENSORS FOR THE OEX ARE TIED TO EQUIPMENT IN THE
SSO.

APPENDIX C
ASSESSMENT WORKSHEET

ASSESSMENT DATE: 9/08/87   NASA DATA:
ASSESSMENT ID: OEX-1000X   BASELINE [X]
NASA FMEA #:   ACIP08-1   NEW [   ]

SUBSYSTEM: OEX
MDAC ID: 1000
ITEM: FDM-FM41, FMF-3

LEAD ANALYST: J. COMPTON

ASSESSMENT:

            CRITICALITY   REDUNDANCY SCREENS   CIL
               FLIGHT   ITEM
            HDW/FUNC   A   B   C

    NASA   [3 /3]   [   ]   [   ]   [   ]   [   ] *
     IOA   [/]   [   ]   [   ]   [   ]   [   ]

COMPARE   [N /N]   [   ]   [   ]   [   ]   [   ]

RECOMMENDATIONS: (If different from NASA)

           [/]   [   ]   [   ]   [   ]   [D]
                                                      (ADD/DELETE)

* CIL RETENTION RATIONALE: (If applicable)
                                          ADEQUATE   [   ]
                                          INADEQUATE [   ]
REMARKS:
ITEM WAS ONLY ON OV-099 (CHALLENGER). ASSUME FMEA NOT NEEDED ANY
MORE.

APPENDIX D

CRITICAL ITEMS

NASA FMEA	MDAC ID	ITEM	FAILURE MODE
SED01-1	101	SEADS PRESSURE PORTS	STRUCTURAL FAILURE

APPENDIX E
DETAILED ANALYSIS

This appendix contains the IOA analysis worksheets supplementing previous results reported in STSEOS Working Paper 1.0-WP-VA87001-07, Analysis of the Orbiter Experiment, (21 August 1987). Prior results were obtained independently and documented before starting the FMEA/CIL assessment activity. Supplemental analysis was performed to address failure modes not previously considered by the IOA. Each sheet identifies the hardware item being analyzed, parent assembly and function performed. For each failure mode possible causes are identified, and hardware and functional criticality for each mission phase are determined as described in NSTS 22206, Instructions for Preparation of FMEA and CIL, 10 October 1986. Failure mode effects are described at the bottom of each sheet and worst case criticality is identified at the top.

LEGEND FOR IOA ANALYSIS WORKSHEETS

Hardware Criticalities:
    1   = Loss of life or vehicle
    2   = Loss of mission or next failure of any redundant item
           (like or unlike) could cause loss of life/vehicle
    3   = All others

Functional Criticalities:
    1R = Redundant hardware items (like or unlike) all of which,
          if failed, could cause loss of life or vehicle.
    2R = Redundant hardware items (like or unlike) all of which,
          if failed, could cause loss of mission.

Redundancy Screen A:
    1   = Is Checked Out PreFlight
    2   = Is Capable of Check Out PreFlight
    3   = Not Capable of Check Out PreFlight
    NA = Not Applicable

Redundancy Screens B and C:
    P   = Passed Screen
    F   = Failed Screen
    NA = Not Applicable

No new analysis worksheets generated as a result of the assessment.

INDEPENDENT ORBITER ASSESSMENT
ORBITER SUBSYSTEM ANALYSIS WORKSHEET

DATE: 2/04/88   HIGHEST CRITICALITY   HDW/FUNC
SUBSYSTEM: OEX   FLIGHT: /
MDAC ID: 1000   ABORT: /

ITEM: FDM-FM41, FMF-3
FAILURE MODE:

LEAD ANALYST: J. COMPTON   SUBSYS LEAD: J. COMPTON

BREAKDOWN HIERARCHY:
 1)
 2)
 3)
 4)
 5)
 6)
 7)
 8)
 9)

                          CRITICALITIES
     FLIGHT PHASE   HDW/FUNC   ABORT   HDW/FUNC
        PRELAUNCH: /   RTLS: /
        LIFTOFF: /   TAL: /
        ONORBIT: /   AOA: /
        DEORBIT: /   ATO: /
        LANDING/SAFING: /

REDUNDANCY SCREENS: A [   ]   B [   ]   C [   ]

LOCATION:
PART NUMBER:

CAUSES:

EFFECTS/RATIONALE:
NOT REQUIRED; ITEM WAS ONLY ON OV-099 VEHICLE.

REFERENCES:

APPENDIX F

NASA FMEA TO IOA WORKSHEET CROSS REFERENCE/RECOMMENDATIONS

This section provides a cross reference between the NASA FMEA and corresponding IOA analysis worksheet(s) included in Appendix E. The Appendix F identifies: NASA FMEA Number, IOA Assessment Number, NASA criticality and redundancy screen data, and IOA recommendations.

Appendix F Legend

Code   Definition

1   IOA recommends changing the second failure mode described in the effects field.

2   IOA recommends deleting the IOA failure mode.

APPENDIX F

NASA FMEA TO IOA WORKSHEET CROSS REFERENCE / RECOMMENDATIONS

NASA FMEA NUMBER	IOA ASSESSMENT NUMBER	CRIT HW/F	SCREENS A B C	CRIT HW/F	SCREENS A B C	OTHER (SEE LEGEND CODE)	ISSUE
	OEX-100	/		/		3	
	OEX-102	/		3/3		2	X
	OEX-103	/		3/3		2	X
	OEX-104	/		3/3		2	X
	OEX-105	/		3/3		2	X
	OEX-202	/		3/3		2	X
	OEX-203	/		3/3		2	X
	OEX-204	/		3/3		2	X
	OEX-205	/		3/3		2	X
	OEX-301	/		3/3		2	X
	OEX-303	/		3/3		2	X
	OEX-403	/		3/3		2	X
	OEX-426	/		3/3		2	X
	OEX-500	/		3/3		2	X
	OEX-501	/		3/3		2	X
	OEX-502	/		3/3		2	X
	OEX-503	/		3/3		2	X
	OEX-504	/		3/3		2	X
	OEX-505	/		3/3		2	X
	OEX-506	/		3/3		2	X
	OEX-507	/		3/3		2	X
	OEX-606	/		3/3		2	X
(SEE REMARKS)	OEX-400	3/3		/			
	OEX-417	3/3		/			
	OEX-418	3/3		/			
	OEX-419	3/3		/			
	OEX-420	3/3		/			
	OEX-423	3/3		/			
	OEX-424	3/3		/			
	OEX-425	3/3		/			
ACIP01-1	OEX-509	3/3		/			
ACIP01-2	OEX-510	3/3		/			
ACIP02-1	OEX-511	3/3		/			
ACIP02-2	OEX-512	3/3		/			
ACIP03-1	OEX-513	3/3		/			
ACIP04-1	OEX-514	3/3		/			
ACIP04-2	OEX-515	3/3		/			
ACIP05-1	OEX-516	3/3		/			
ACIP05-2	OEX-517	3/3		/			
ACIP06-1	OEX-508	3/3		/			
ACIP07-1	OEX-600	3/3		/			
ACIP08-1	OEX-1000X	3/3		/		1	X
ACIP10-1	OEX-601	3/3		/			
ACIP10-2	OEX-602	3/3		/			
ACIP11-1	OEX-603	3/3		/			

NASA FMEA NUMBER	IOA ASSESSMENT NUMBER	CRIT HW/F	SCREENS A B C	CRIT HW/F	SCREENS A B C	OTHER (SEE LEGEND CODE)	ISSUE
ACIP11-2	OEX-604	3/3		/			
ACIP12-1	OEX-520	3/3		/			
ACIP12-2	OEX-521	3/3		/			
ACIP13-1	OEX-605	3/3		/			
ACIP14-1	OEX-519	3/3		/			
ACIP14-2	OEX-519	3/3		/			
DCM ELECTRONICS 7	OEX-421	3/3		/			
	OEX-422	3/3		/			
FWFS01-1	OEX-300	3/1R	P NA P	3/3		1	X
FWFS02-1, SUMS 1, 2,	OEX-200	3/1R	P NA P	3/3		1	X
FWFS02-2, SUMS-20, 2	OEX-201	3/3		/			
FWFS03-1	OEX-302	3/3		/			
FWFS04-1	OEX-304	3/3		/			
PRESSURE (PIN PULLER	OEX-416	3/3		/			
PRESSURE (WINDOW) 1	OEX-415	3/3		/			
PRESSURE 11	OEX-407	3/3		/			
PRESSURE 14	OEX-408	3/3		/			
PRESSURE 16	OEX-409	3/3		/			
PRESSURE 17	OEX-410	3/3		/			
PRESSURE 20	OEX-411	3/3		/			
PRESSURE 21	OEX-412	3/3		/			
	OEX-413	3/3		/			
PRESSURE 4	OEX-401	3/3		/			
PRESSURE 6	OEX-402	3/3		/			
PRESSURE 7	OEX-404	3/3		/			
PRESSURE 8	OEX-405	3/3		/			
PRESSURE 9	OEX-406	3/3		/			
SED01-1	OEX-101	1/1		/			
SUMS-10	OEX-213	3/3		/			
SUMS-11, 12, 16 AND	OEX-214	3/3		/			
SUMS-13, 14 AND 17	OEX-215	3/3		/			
SUMS-5 AND 7	OEX-206	3/3		/			
SUMS-5, 7 AND 19	OEX-208	3/3		/			
SUMS-6	OEX-207	3/3		/			
	OEX-209	3/3		/			
	OEX-211	3/3		/			
SUMS-8 AND 15	OEX-210	3/3		/			
SUMS-9	OEX-212	3/3		/			

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1.0 EXECUTIVE SUMMARY

The McDonnell Douglas Astronautics Company (MDAC) was selected in June 1986 to perform an Independent Orbiter Assessment (IOA) of the Failure Modes and Effects Analysis (FMEA) and Critical Items List (CIL). Direction was given by the STS Orbiter and GFE Projects Office to perform the hardware analysis using the instructions and ground rules defined in NSTS 22206, Instructions for Preparation of FMEA and CIL, 10 October 1986.

The IOA effort first completed an analysis of the Orbiter Experiments (OEX) hardware, generating draft failure modes and potential critical items. To preserve independence, this analysis was accomplished without reliance upon the results contained within the NASA FMEA/CIL documentation. The IOA results were then compared to the NASA FMEA/CIL baseline with proposed Post 51-L updates included. A resolution of each discrepancy from the comparison is provided through additional analysis as required. This report documents the results of that comparison for the Orbiter OEX hardware.

The IOA product for the OEX analysis consisted of eighty two failure mode "worksheets" that resulted in two potential critical items being identified. Comparison was made to the NASA baseline (as of 1 May 1987) which consisted of one hundred ninety one FMEAs and one CIL item. The difference in the number of IOA analysis worksheets and NASA FMEAs can be explained by the different levels of analysis detail performed to identify failure modes. The comparison determined if there were any results which had been found by the IOA but were not in the NASA baseline. This comparison produced agreement on all but twenty four FMEAs which caused differences in no CIL items. Figure 1 presents a comparison of the proposed Post 51-L NASA baseline, with the IOA recommended baseline, and any issues.

The issues arose due to differences between the NASA and IOA FMEA/CIL preparation instructions. NASA had used an older ground rules document which has since been superseded by the NSTS 22206 used by the IOA. After comparison, there were no discrepancies found that were not already identified by NASA, and the remaining issues may be attributed to differences in ground rules.

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